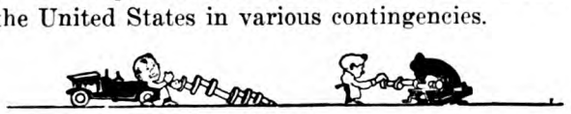
EDITORIAL

Part-Time Classes Starting

With the school year opened in many California communities, and about to open in the rest of the State, preparations are being made for classes under the new Part-Time Education Act, and some classes have already been opened. Those in charge of the work report that the number of working boys and girls admitting that they are under 17 is abnormally small. It is also unfortunately true that, while many employers are showing that they recognize the advantages to be gained from the Act to themselves as well as to the public, others are tacitly or actively encouraging perjury by their boy and girl employees regarding their ages.

Ship Sale Plans Announced

Plans for the sale of the entire Shipping Board fleet of 1200 steel vessels, of approximately 5,000,000 deadweight tons, have been announced, and efforts will also be made to move the wooden ships still remaining on the Board's hands. The minimum prices fixed for coal-burners range from $160 to $175 per ton, and for oil-burners $170 to $185. Deduction from these prices for depreciation is allowed at the rate of 6% for the second year of the vessel's age and 5% for each succeeding year until the date of purchase. It is one thing to name a price and another thing to get it. However, we may reasonably suppose that the members of the Board would not have fixed these minimum prices unless they had grounds for believing that such prices were fair and could be obtained for most of the fleet at least. On the other hand, fixing these prices does not prevent the ships being sold at higher figures, if they can be obtained. The prices mentioned are lower than Pacific Coast builders claim they should get for ships to be built at the present time. In fact, shortly before the Skinner & Eddy yards were closed, a member of that corporation stated that he would not consider any price for freighters under $200 per ton. The terms prescribed are 10% cash, 5% in 6, 12, 18, and 24 months, respectively, and the remaining 70% in equal semi-annually installments over a period of ten years. The interest rate on deferred payment is 5%. Other provisions announced protect the interest of the United States in various contingencies.



German Efficiency Again

Both German efficiency and the damage done to the interned German ships when America entered the War have been so fully discussed as to call for an apology at any further mention of either subject. However, the head of an Eastern shipyard has called attention to what appears to be a new aspect of both matters. He says: "If 400 American or British engineers had been told to put the machinery of their ships out of business, we know that the job would have been as thoroughly done as any German engineer could do it. Each of them would have used his own methods irrespective of orders, which his government would not have been likely to have given. But before the War, the German engineers of vessels like the 'Leviathan', and the others we took over, had specific and detailed instructions as to the maiming of each particular piece of machinery. It was to be done in exact conformity with the orders dictated by German efficiency. The damage produced seemed not only thorough but irretrievable. But when we had guessed the riddle of one of these boats we knew exactly what to look for in the next. Germany gave us only one problem and we solved that. American or British engineers, with an individual efficiency far greater than the German kind, would have given us a separate problem on every boat. That is why all the German vessels were in service against her in an apparently impossible period of time, where, if conditions had been reversed, Germany could not have made nearly so many available."

Money for Safety Work Needed

Attention is called to the article in another column describing the serious results of careless practice in the use of high-pressure tanks containing gases. This is only one of many classes of accidents that the Department of Safety of the Industrial Accident Commission of California is trying to prevent entirely or at least to reduce to a minimum. It is unnecessary to discuss at length the good work accomplished by the Department since its organization in January 1914. The engineers and inspectors of its staff have co-operated with, rather than spied upon, the employers of the State, and the fruit of such co-operation has been the prevention of hundreds of accidents and the saving of thousands of dollars in damage claims and premiums to the employers. It is unfortunate that such a useful department should be so inadequately manned, the entire force of engineers and inspectors, which, in theory at least, has to cover the whole State, comprising only 24 men. Of the seven divisions, construction, electrical, elevator, boiler, factory, mining, and shipbuilding, only two, the boiler and elevator divisions, have a sufficient staff, and this is because the fees these divisions collect make them self-supporting. There are only two men to cover all the factories in the State. The next legislature should appropriate enough money for the Department of Safety to permit

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the employment of an adequate force. At the same time the enlargement of the functions of the Department to cover safety matters not directly industrial, such as safety on the highways, might well be considered. At the present time, the enforcement of regulations governing highway traffic outside of incorporated towns leaves much to be desired.

Electric Power Curtailment

The expected has happened. Drastic curtailment of deliveries of electric power to all northern and central Californian industries, including street-railway systems, was ordered on August 19. In brief, the order calls for a reduction of 20% in the use of electric energy for power purposes, except domestic use and use in connection with growing crops and the handling of perishable goods, and for economy in the use of power for lighting. The reduction required is to be made, as far as possible, between the hours of 7 a.m. and 10 p.m. Use of power for irrigation of vacant lands or of lands from which the crops have been harvested is prohibited during the present shortage. Power users in southern California and in the San Joaquin valley south of Merced are not affected, as the supply available for these districts is adequate, although not plentiful. Even if there were a surplus, it could not be used to relieve the shortage farther north because of mechanical difficulties. We wonder if there will be a cry that the power companies have been exporting large quantities of power in order to create an artificial shortage. The agricultural need for power will be diminished at the close of the rice-irrigating season, but the relief will probably be insufficient to permit any change in the restrictions, and we may expect them to remain in force until the autumn rains increase the stream-flow materially. Projects under way or else under consideration now that sensible Federal water-power legislation has been enacted, make the repetition of such a shortage improbable. Meanwhile, complaining will do no good. The order may ultimately prove beneficial to some shop-owners, since there are few plants where a careful survey will not disclose considerable preventable waste of power. In some cases this might be enough to make up for the 20% reduction. If such relatively simple expedients are not sufficient to meet the emergency, rearrangement of working schedules may become necessary. The off-peak hours from 10 p.m. to 7 a.m. give time for a night shift, not necessarily at the most convenient time, but, nevertheless, a better arrangement than curtailment of operations and working-forces.

Railroad Rates Increased

The people are getting some valuable, and expensive, object-lessons illustrating the fact that they and they alone must pay the cost of wage-increases or any other increases in cost of production or operation. In the long run, Mr. Ulti M. Consumer is the man that pays the bill, the whole bill, and should be thankful if he pays nothing but the bill. Such being the case, no one was particularly surprised when the Interstate Commerce Commission announced increases in inter-state rates, which, if applied according to their recommendations to intra-state rates as well, should increase freight and passenger income about $1,600,000,000 per year. The increases are adjusted as nearly as possible to provide for the new wage increases and to yield 6% on the valuation of the railroads assumed by the Commission.

Nobody likes to pay increased rates for anything. We would all like to retain our 1920 income and pay 1896 prices. However, in the case of the railroads, something had to be done, and done quickly. If the granting of these new rates will permit the railroads ultimately to attain their old-time efficiency, it will be well worth while. Nothing more than a rough estimate can be made of the tax being paid by the industries, and through them, the consumers of the United States, because of inadequate transportation facilities, but some conception of the total amount may be gained by considering the steel industry, for instance. Under normal conditions (how long ago it seems!) the warehouse price at San Francisco, of the various steel products, was approximately equal to the Pittsburgh price plus the freight from Pittsburgh to San Francisco. Nowadays, the so-called Pittsburgh price is not even an indication of the price you will have to pay at Pittsburgh for early delivery, while the virtual premium for early delivery in San Francisco may easily exceed the freight charge. This is, provided you can get the stuff at all. An employee of a local shop recently spent all one day trying to gather 1000 half-inch nuts, and was able to get only 500 after combing practically the entire Bay district. How much could that shop have afforded to pay in freight to ensure delivery of the entire order and no necessity for scouring the countryside?

Turning to the special case of the Pacific Coast metal manufacturer, the freight increases seem likely in the long run, to help his business. Increase of the freight differential amounts practically to a direct bonus to the Coast steel-mill, and will have the same effect on any enterprise for direct production from the ore, whether by blast-furnace or electric furnace, should such an enterprise be developed. The ordinary manufacturer, who buys his raw materials, will have to pay more for them, but, on the other hand, the increase of the tariff on manufactured goods is proportionately higher, since all raises are expressed in straight percentages, and the manufactured goods rate was higher to start. The Western manufacturer ought, therefore, to be in a better position than before to meet Eastern competition, while his local competitors are, at least, in the same boat with him. There is, of course, the possibility that increased costs of production may force a selling price greater than the traffic will bear, but this is not likely to happen often, if at all.

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SAN FRANCISCO OFFICE AND WAREHOUSE OF DITTY BROS., INC.

Building Business on Service; the Place of the Supply House in the Metal Industry

By D. C. FESSENDEN

Modern business men today realize that a successful business cannot be built on the principle of caveat emptor, or, to put it in plain English, 'let the purchaser beware'. Modern theory has it that a sale is not successful unless both seller and buyer are satisfied and make a profit. Much has been said and written on the new theory and 'service' has become a by-word among salesmen, but unfortunately, like Rube Goldberg's boobs, it doesn't mean anything in many cases.

What then is the value to the trade of the modern supply and equipment house that takes as much pains to see that its customers make a profit as it does to make a profit itself? Does it pay to play the right game? Is there a place in business for the Golden Rule? Is 'real service' appreciated and does it spell success even in this day when it is touted as the principal commodity of every business?

To reach an answer to these questions, there is no better method than to consider the record made by a progressive supply house such as Ditty Bros., Inc., who do a large part of the foundry equipment business in the West. I use them as an example because I have seen their rise from small beginning during the two years in which I have had personal relations with them. I know the personnel and I believe that I understand the factors that have contributed to their success.

The business now operating as Ditty Bros., Inc., was started in a small way in Seattle, only four years ago, by T. R. Ditty, the president and treasurer of the company. The only commodity handled was foundry facings, these being brought from the East in small lots. Mr. Ditty had previously been associated with his brother, Ralph Ditty, in the foundry-supply business in the East, the original manufacturers of foundry flour and pitch core-binders, which are now used so extensively throughout the country. T. R. Ditty was shortly joined by his brother, F. L. Ditty, and it is as a result of their work and the service that they gave that the present business has been built up.

The keen competitive conditions under which the Eastern foundryman operates has forced him to take advantage of every forward step in foundry practice until today his plant is a model of efficiency. He is constantly on the alert for cost-reducing equipment, labor-saving devices, and short-cuts of all kinds. He usually feels that he has no time to wait until his neighbor proves the worth of a new piece of equipment, but prefers to demonstrate it himself. Distances are small in the East, and he often knows the result of his neighbor's experiments almost as soon as his neighbor does himself. He religiously attends the conventions and usually sees that his foremen are there. He devotes a certain amount of time each year to

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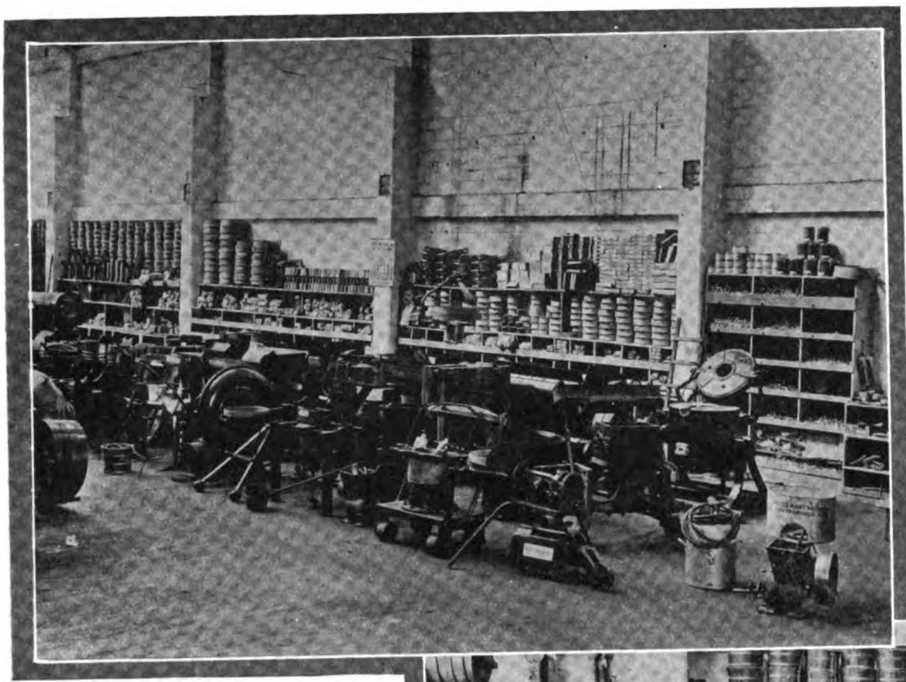

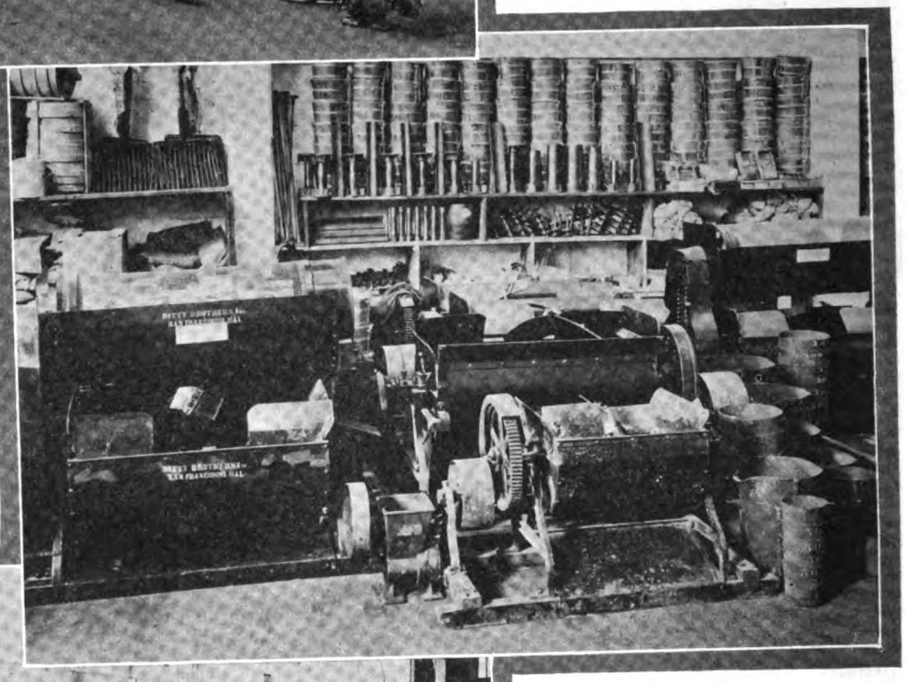

INTERIOR VIEWS OF SAN FRANCISCO WAREHOUSE, SHOWING VARIETY OF SUPPLIES AND EQUIPMENT CARRIED.

visiting other modern plants. Conditions on the Pacific Coast are different. Due to our splendid isolation, we have not realized the necessity for keeping pace with our Eastern neighbor, but the far-sighted man realizes that the competition in the future is not so much with his immediate neighbor as with the Eastern foundrymen who are reaching out to the Coast as a virgin field, especially for production work. The introduction of modern methods and equipment is one of the chief opportunities for service that the supply man has. In this work the Ditty brothers are playing an important part. They study the needs of their customers as the doctor studies his patient. They attend the foundry conventions regularly, and each year one of the firm visits the most modern foundries in the East for the sole purpose of learning the latest in money-making methods and machine development. The manufacturers of modern equipment in the country have been thoroughly canvassed; their product has been investigated and only the best is placed before the industry that the best possible equipment for the work in hand can be offered. As a result of the realization of the great saving that could be made in the cleaning-room by

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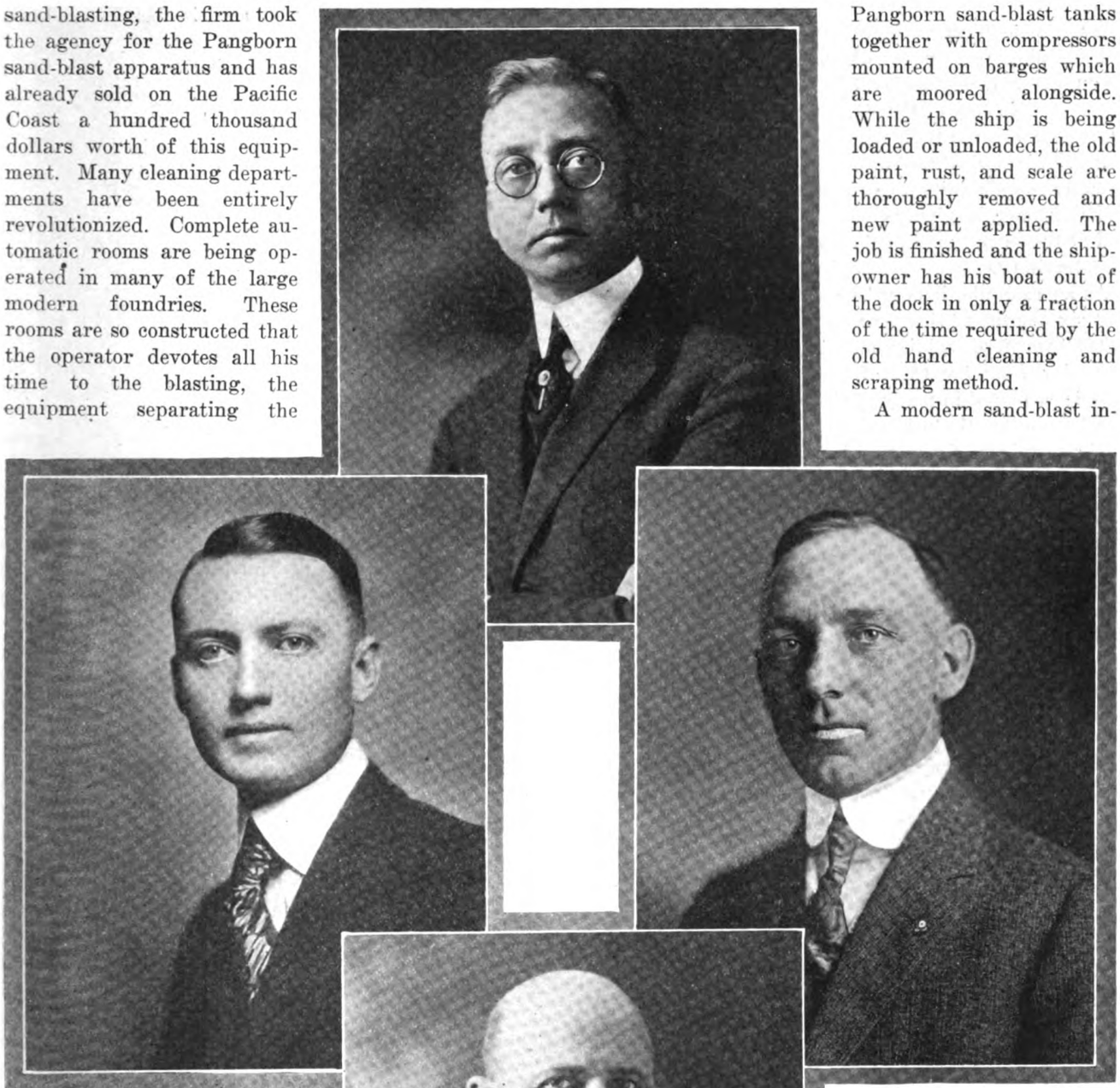
sand-blasting, the firm took the agency for the Pangborn sand-blast apparatus and has already sold on the Pacific Coast a hundred thousand dollars worth of this equipment. Many cleaning departments have been entirely revolutionized. Complete automatic rooms are being operated in many of the large modern foundries. These rooms are so constructed that the operator devotes all his time to the blasting, the equipment separating the



ABOVE, T. R. DITTY, PRESIDENT AND TREASURER OF THE FIRM. ON LEFT, F. L. DITTY, SECRETARY.

ON RIGHT, R. A. CLARK, NORTH-WEST MANAGER. BELOW, J. A. HAYDEN, MANAGER CORE-OIL DEPARTMENT.

sand, removing the dust-laden air, etc., and effecting a great saving in cost over other methods. Probably the only installation in the country for sand-blasting of ships preparatory to re-painting as they lie either in dry-docks or in the water is being operated in the Bay district. This consists of several Pangborn sand-blast tanks together with compressors mounted on barges which are moored alongside. While the ship is being loaded or unloaded, the old paint, rust, and scale are thoroughly removed and new paint applied. The job is finished and the shipowner has his boat out of the dock in only a fraction of the time required by the old hand cleaning and scraping method.

A modern sand-blast installation is now being operated near Fresno, removing paint, rust, and scale from oil-line pipe that has lain in the soil for 10 to 12 years. Ten times as much surface is cleaned as can be done by hand, and the scale is removed down to the virgin metal.

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A number of foundrymen on the Pacific Coast are making some form of foundry equipment, but in spite of being able to compete with the Eastern manufacturers on quality and outclassing him on deliveries, they have not been able to get distribution of their manufactured equipment because their principal business was not with foundries but with machine-shops. This has given Ditty Bros. an opportunity to benefit both the manufacturer and consumer in giving distribution to this equipment, and at the same time to help the foundry industry in its sales-territory.

As an example, it may be mentioned that during the first six months of this year Ditty Bros. installed nearly $20,000 worth of molding machines manufactured by the Macauley Foundry Co., of Berkeley. These machines have been placed in many of the largest foundries on the Coast from Seattle to Los Angeles.

The members of the firm have given a great deal of thought and study to molding-machines, realizing that they are an important factor in reducing manufacturing costs, especially on production work. They have installed every type of molding-machine on the market, from the simple hand-operated squeezer to the more complicated 'roll-overs'. Molding-machines have been sadly neglected by the Coast foundryman, and until he realizes the tremendous possibilities of machine work he will be operating at a serious disadvantage. It is not uncommon to see production jump from 25 or 30 flasks to 135 flasks per man per day when the molding-machines are installed. In Eastern foundries most of the molds are made on machines at a great saving in the cost of castings. This is one of the reasons why, even after paying the freight, the Easterner is able to compete with local foundrymen. There is scarcely a foundryman on the Coast but who has some class of work going through his foundry that can be adapted to some type of molding-machine.

The core-oil department has grown to be one of the most important of the firms' activities. They have developed oils which have effected extensive saving to the users. A practical core-maker of many years experience is in charge of this department, and it is his business to help the foundrymen with their core problems. As a result of this service the bulk of the core-oil used on the Coast is furnished by this firm.

While it is true that Pacific Coast foundrymen frequently find themselves at a disadvantage in competition with the Eastern manufacturer, on the other hand, it is largely through the efforts of the Ditty brothers that modern core-ovens are being made on the Coast for the firm and deliveries are made in an average of two weeks and at a considerable saving over the cost of the Eastern oven. Both drawer-type day-ovens and the large track night-ovens are being built. Two of these night-ovens complete including cars, all made locally, were recently installed in the Metal Trades Foundry and a large 10 by 20-ft. oven is now under construction at the foundry of Henry Dalton & Son. Ovens are being shipped to other cities and the demand for them is increasing rapidly. Locally-made, motor-enclosed, self-driven swing-grinders and traveling foundry-cranes are also being distributed by the firm.

A used-equipment department is the outgrowth of the firm's practice of disposing of excess equipment for the foundrymen with whom they do business. There is a large call for used equipment, particularly when time is an element in the transaction. It often happens that a foundryman starting in one place may need exactly the equipment that another foundryman has just outgrown. In the deal both parties benefit. The latest achievement in the second-hand equipment line was the purchase of the foundry of the Skinner & Eddy Corporation of Seattle, the largest in the North-West. The purchase was made at a moderate cost and the benefit passed along to the purchasing foundrymen. A car of this material was recently delivered in Los Angeles at a saving of easily $1000 as compared with new equipment. A great amount of money is tied up in idle equipment and it is a considerable service to both the buyer and the seller of this material to bring them together.

Ditty Bros. have given careful study and thought to foundry design and have completely equipped a number of the most modern foundries on the Coast, particularly manufacturing foundries. The foundries of the Gulowsen-Grei Engine Co., of Seattle, the C. F. Braun Co., of San Francisco, W. H. Jahns, of Los Angeles, and the Keystone Iron & Steel Works, of Los Angeles, are among the manufacturing foundries that have been completely equipped by this firm.

The splendid success of this firm in building up such a large business in the short space of four years is due to two principal causes, the first is that service and square dealing has won for them respect and confidence so that every customer is a steady customer. The second is that they have gone after the business aggressively in every way they know how, through personal solicitation and through publicity methods, with the result that there is no foundry from Alaska to the Mexican border in which the name of Ditty Bros., Inc., is not known. In this publicity, we are proud to say that 'Metal Trades' has played no inconsiderable part.

CHAUNCEY DEPEW was accosted in the lobby of the Blackstone by a woman reporter from Los Angeles, who asked his name, and duly recorded it.

"Where are you from?" she asked.

"Peekskill," replied Mr. Depew.

"Where's that?"

"In New York."

"Are you a delegate?"

"Yes."

"Whom are you for?"

"Butler."

"Who is your second choice, Mr. Depew?"

"My dear woman," Mr. Depew replied with a twinkle, "if I were courting you, and you had not answered, do you suppose I would tell you my second choice?"—'Los Angeles Times.'

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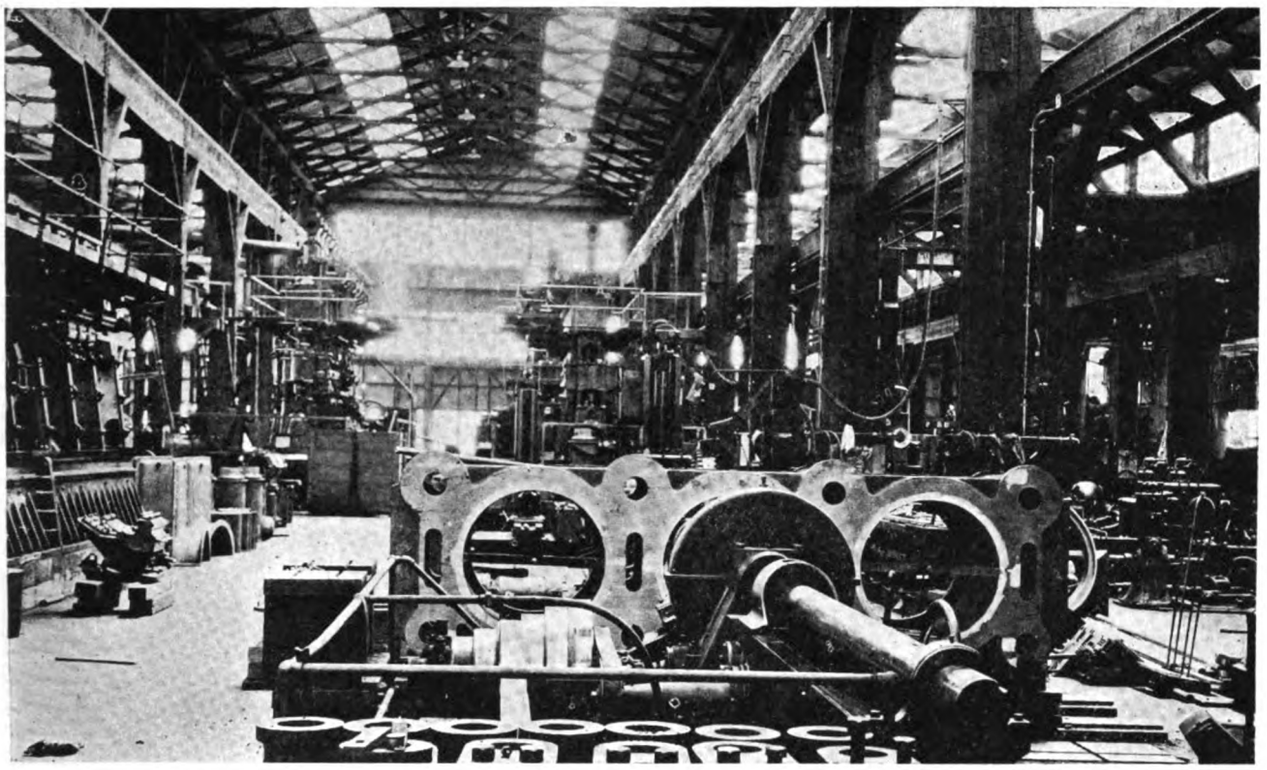

FIG. 6. BORING CYLINDER BLOCK ON BARRETT MILL

Machining Operations on Cylinders for Skandia Werkspoor Engines

The cylinders and cylinder-blocks of the Werkspoor Diesel engines, which the Skandia Pacific Oil Engine Co., of Oakland, is manufacturing in America, exhibit several of the distinctive features of this type as compared with other Diesel engines. The accompanying photographs show the principal machining operations on both

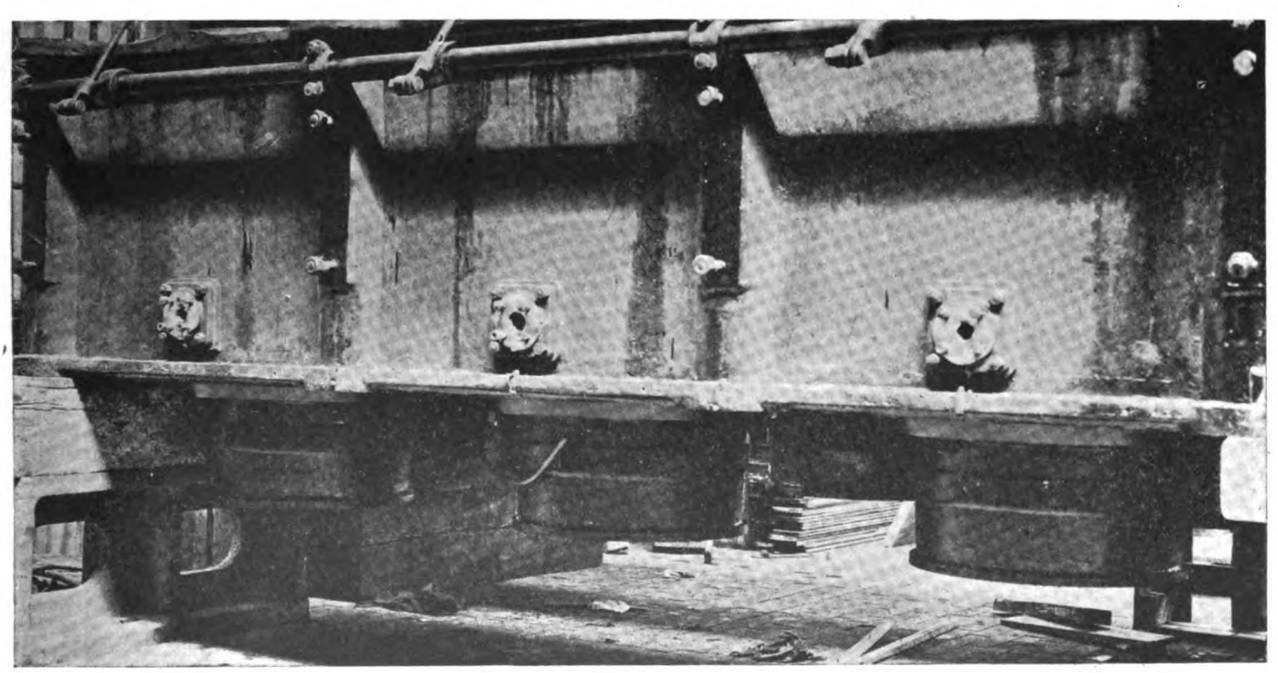

FIG. 7. LOWER PART OF CYLINDERS, SHOWING REMOVABLE SKIRT

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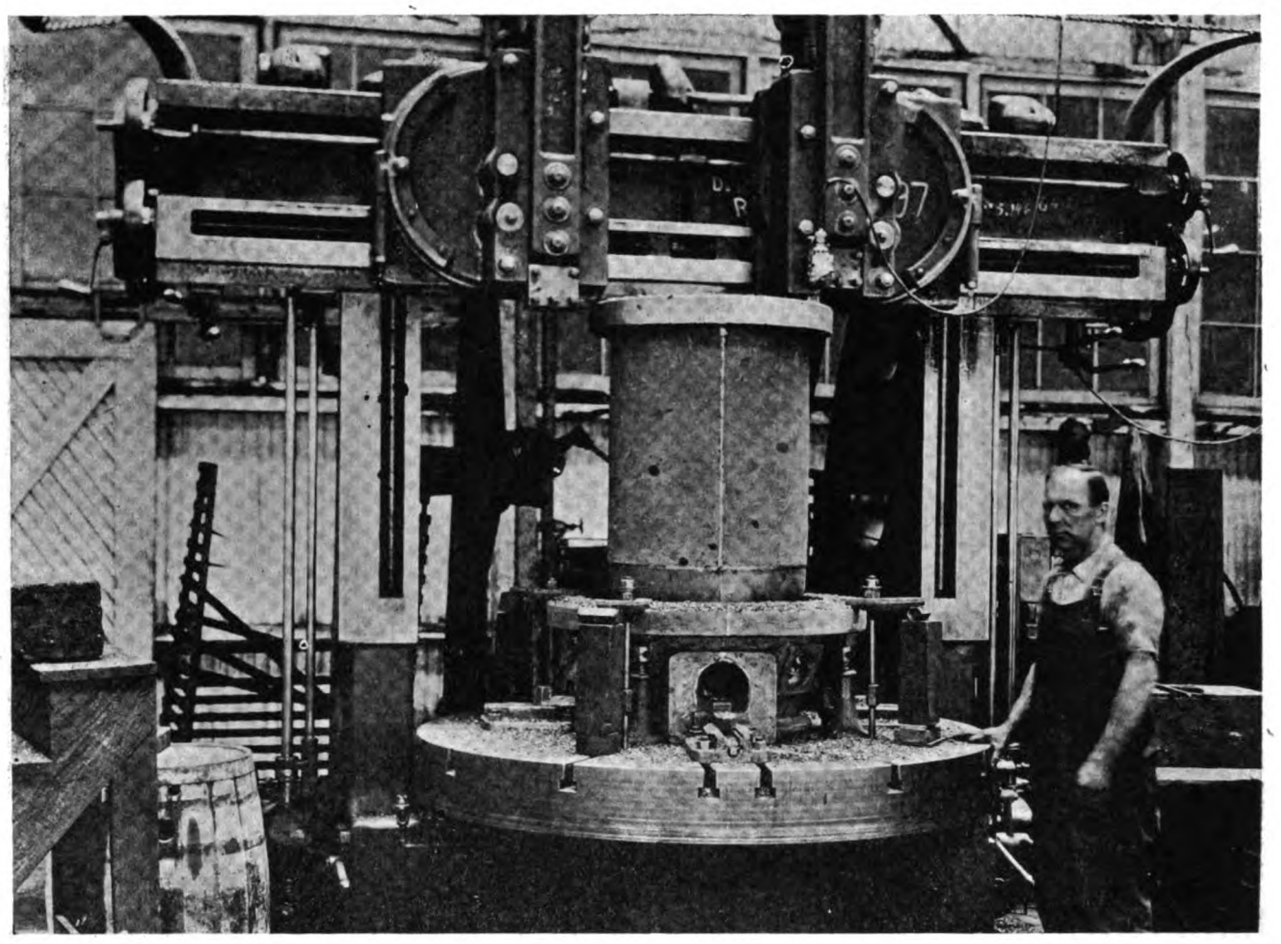

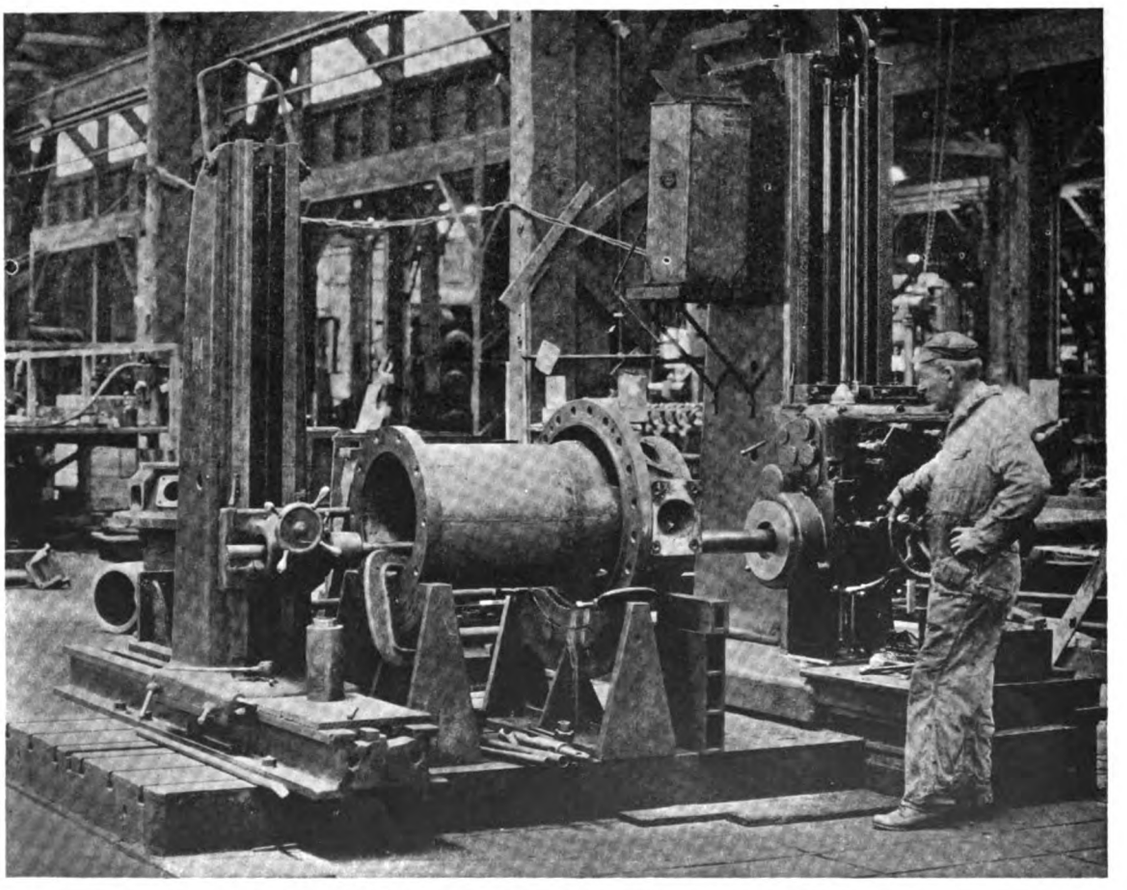

FIG. 1 AND 4. FACING AND TURNING AND BORING CYLINDERS

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cylinders and blocks as well as other features of the work.

Together with all the other castings for these engines, with the exception of the main bed-plate casting, which is too heavy for the foundry-crane equipment, both cylinders and blocks are cast at the Skandia company's foundry. Special care is taken both in proportioning the charge and in the casting methods, and the result is seen in the exceptionally high quality of iron produced. Test-pieces are cast with each heat, and these have shown an ultimate tensile strength ranging from 35,000 to 42,000 lb. per square inch, or about double that of ordinary cast-iron. Another test-piece, 1 in. round, from each heat is tested for transverse strength by being placed on supports 12 in. apart and broken by a weight midway between the supports. Invariably the weight required has been about 3500 lb. and the deflection $\frac{1}{8}$ in. before breaking.

FIG. 2. CYLINDER, SHOWING VALVE-OPENINGS

The accompanying photographs show cylinders for both the 825-hp. and the 550-hp. six-cylinder engines now under construction at the Skandia plant. A more detailed description of these engines is given in the article describing the shop-tests made on them, appearing on page 381 of this issue. The cylinders for the 825-hp. engine have a $20\frac{1}{2}$-in. bore and a $35\frac{1}{2}$-in. stroke. For the 550-hp. the corresponding dimensions ore $16\frac{1}{2}$ and $29\frac{1}{2}$ inches.

Fig. 1 shows the first machining operation on the cylinders, namely, facing both ends and turning the adjacent rims on a King boring-mill. As will be noted, facing and turning are done at the same time. Both a roughing and a finishing cut are taken on this machine. The work on this as well as the other operations on the cylinders is held to a tolerance of 0.001 inch.

Fig. 2 and 3 show nearer views of the cylinders, and also illustrate the high quality of the iron obtained, particularly the freedom from blow-holes and similar defects. Fig. 4 shows the second operation on the cylinders, namely, boring them on a Landis mill.

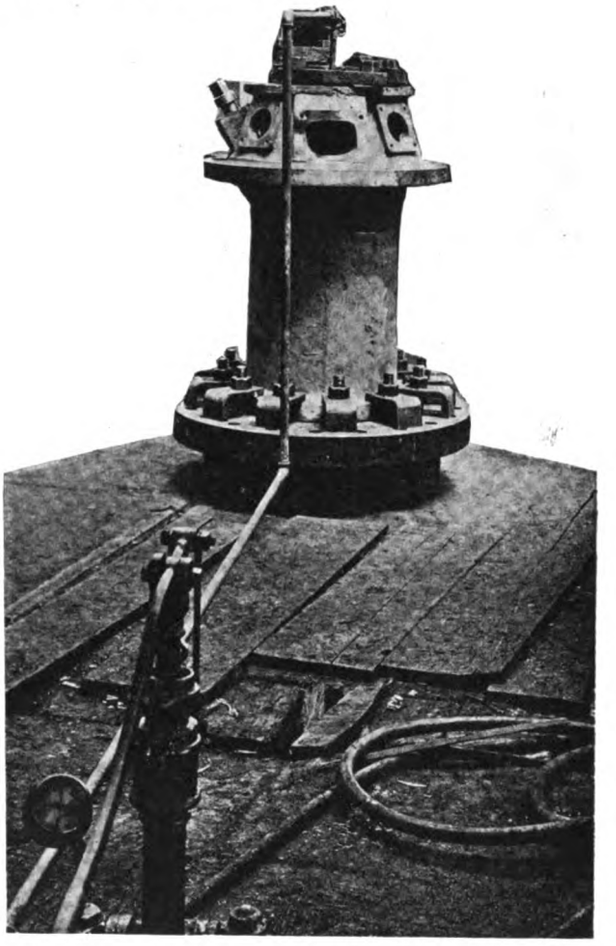

FIG. 5. CYLINDER READY FOR HYDROSTATIC TEST

To guard against any possible defects of manufacture, all cylinders are given a hydrostatic test, as shown in Fig. 5, of 1000 lb. per square inch, and if any leakage is shown, the casting is rejected. Since the maximum working-pressure is less than half of this amount, the factor of safety is ample.

Fig. 6 shows the operation of boring the cylinder-blocks on a Barrett vertical mill. As already noted this arrangement of cylinder and blocks is one of the most important distinctive features of the Werkspoor engine. The set of three cylinders rests in the block, while water circulates freely around them maintaining a uniform temperature at every part of the surface of each cylinder. The block acts as a beam, and the holding-down bolts pass through the holes shown and anchor the block and the

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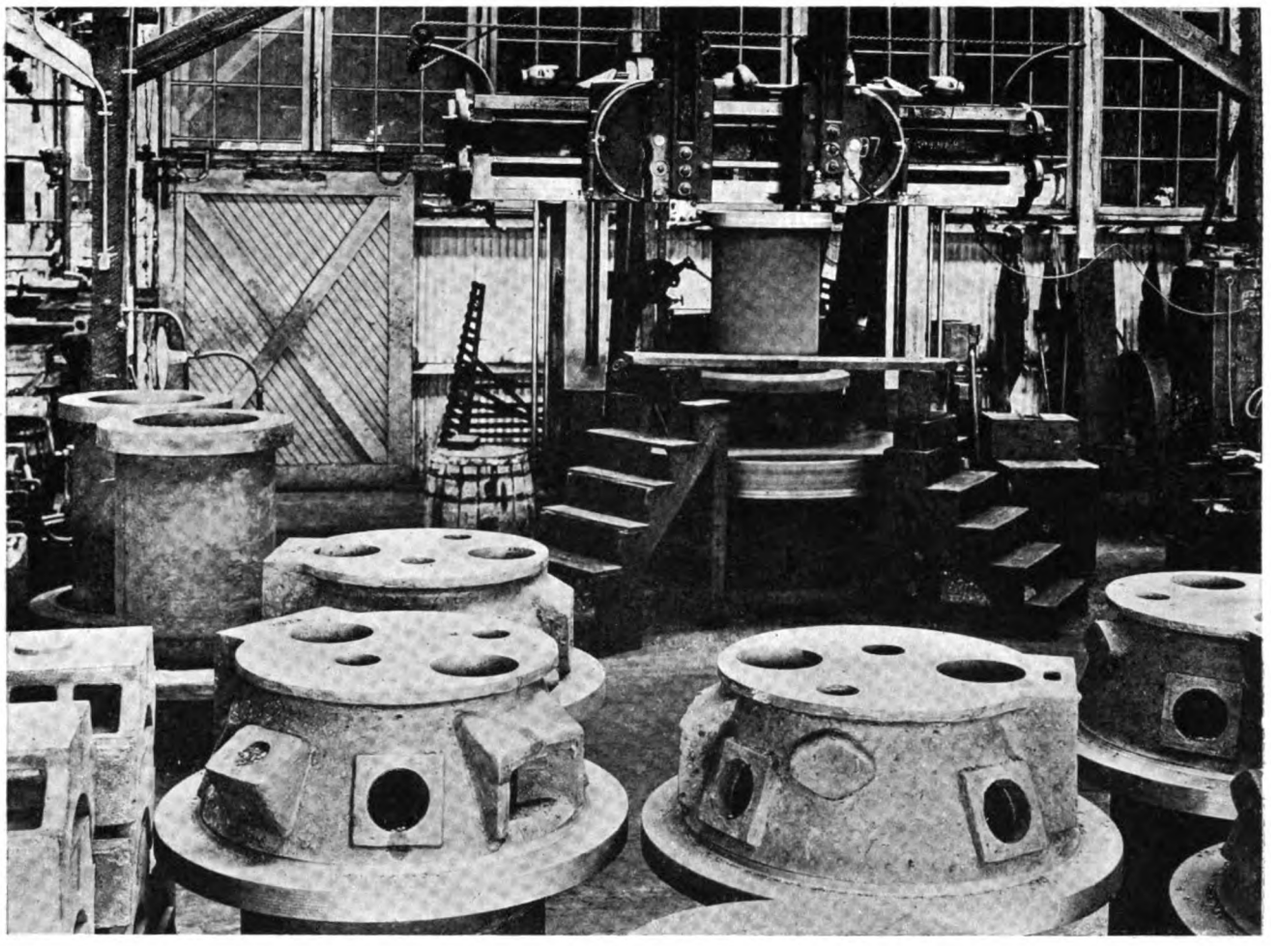

FIG. 3. LOOKING DOWN ON CYLINDERS, BORING-MILL IN BACKGROUND

engine-bed securely together. These two features are the principal factors contributing toward the maximum of strength and rigidity with a minimum of weight and space occupied.

Another important feature of the Werkspoor design is illustrated in Fig. 7, which shows the skirts of the cylinders in place. This skirt can be removed readily, after which operation the crank can be brought to bottom dead-centre, the piston can be pulled downward and removed from the cylinder. This takes most of the 'curse' out of the job of removing pistons, which has been one of the chief bugbears of Diesel engine operation.

Metal-Trades Plants in India

Statistics recently compiled show that there are 74 'engineering workshops', including iron and brass foundries and shipyards, in the province of Bengal, with 15,840 employees, 20 shops and 5387 employees in the province of Bombay, 7 shops and 5278 employees in Bihar and Orissa, 7 shops and 1610 employees in the United Provinces, and 9 shops and 1394 employees in Madras. There are two steel plants, the Bengal Iron & Steel Works at Kulti, employing 6370 men and producing 10,000 tons of pig-iron per month, and the Tata Iron & Steel Works at Sakchi, with 10,775 employees and producing 20,000 tons per month. Most of this pig-iron is converted into steel, which is rolled mainly into rails and small shapes, but even with the additional furnaces now under construction, which in the case of the Tata works will more than triple the output, not more than a fraction of India's needs of iron and steel can be supplied from these two plants.

THE gob was on shore leave and happy because he had found a girl as affectionate as he. His joy was dimmed, however, for a bluecoat had forbidden spooning in the park and his girl had tabooed it in the streets.

But life took on a new turn when he saw a man kiss his wife farewell in front of the Pennsylvania station, New York. He rushed his girl toward a crowd hurrying toward the Philadelphia express and bade her a fond farewell. When the crowd thinned they joined a throng for Washington and repeated the act. They repeated it again before the Chicago train.

This was too much for a colored porter who had been watching. He stepped up to the gob. "Boss," he said, "why don't you go downstairs and try the Long Island station? Dem trains am a'leavin' mos' all de time."—'Los Angeles Times.'

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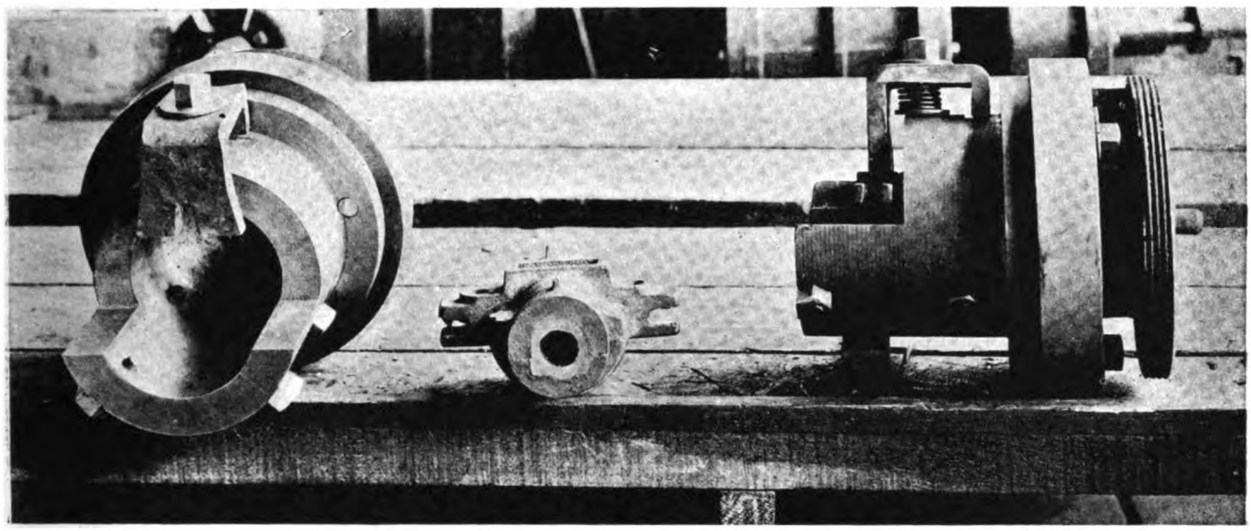

FIG. 3. TURRET-LATHE FIXTURE FOR MACHINING SHAFT-HANGER

Fixtures for Quantity Production

The results obtained on quantity-production jobs when the work is studied and the proper fixtures made are remarkable. The accompanying photographs show a fixture for drilling the flanges of pipe-ells designed by Clevenger & Dietrich and made at the Leon Hommell Machine Works, 416 23rd street, Oakland, for a local manufacturer.

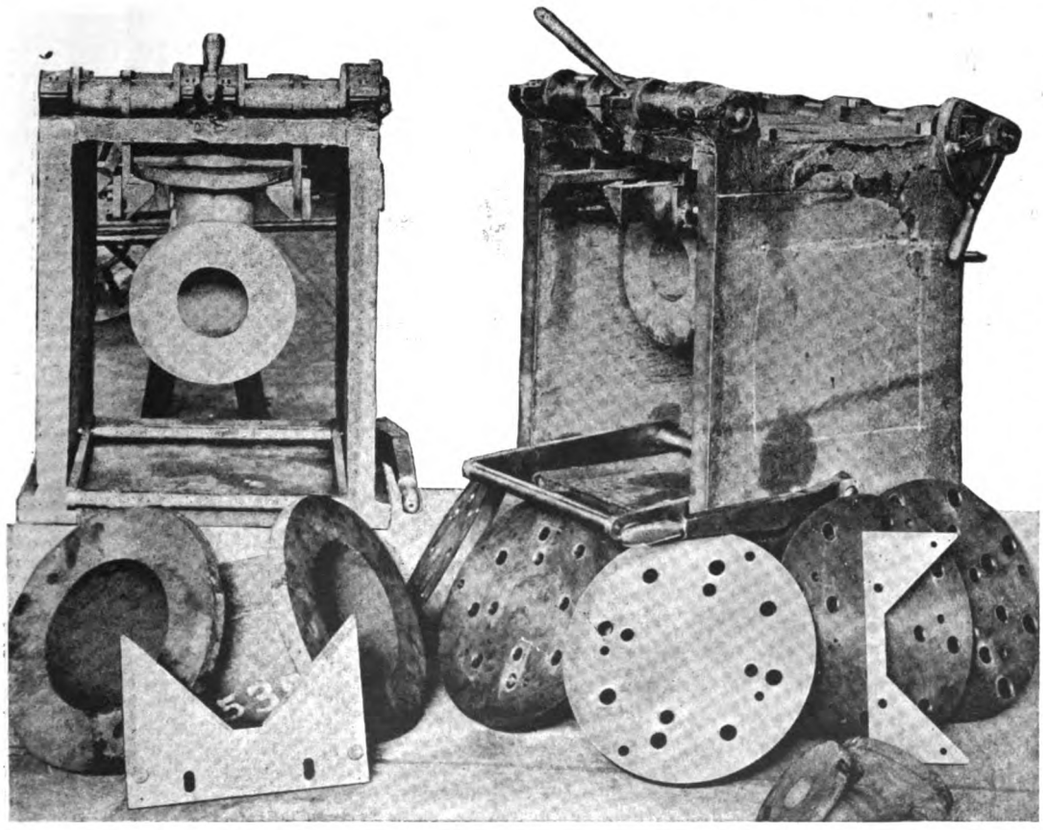

FIG. 1 AND 2. FIXTURE FOR FACING PIPE-ELLS

Fig. 1 shows the fixture with a 4-in. ell in position for drilling. The fixture will handle ten different sizes of pipe from 2 to 8 in. diam. inclusive, by the use of one or other of the set of five plates shown at the base of the fixture. Fig. 2 shows the clamps released and the ell ready to remove. The different plates are held in position on top of the fixture by dowel-pins. The lever at the base is raised to line up the ell when it is placed in position and is then allowed to rest as shown. The two irregularly shaped pieces shown in the foreground are also used in lining up the ell.

Fig. 3 shows two views of a turret-lathe fixture, also made at the Hommell works, for boring and facing the shaft-hanger shown in the middle between the two fixtures. Placing the work in the fixture, centring it, and clamping it in position can all be accomplished in a short time, and the length of time the lathe is idle reduced to a minimum. And the only time that a machine-tool of any kind is making money is when it is running.

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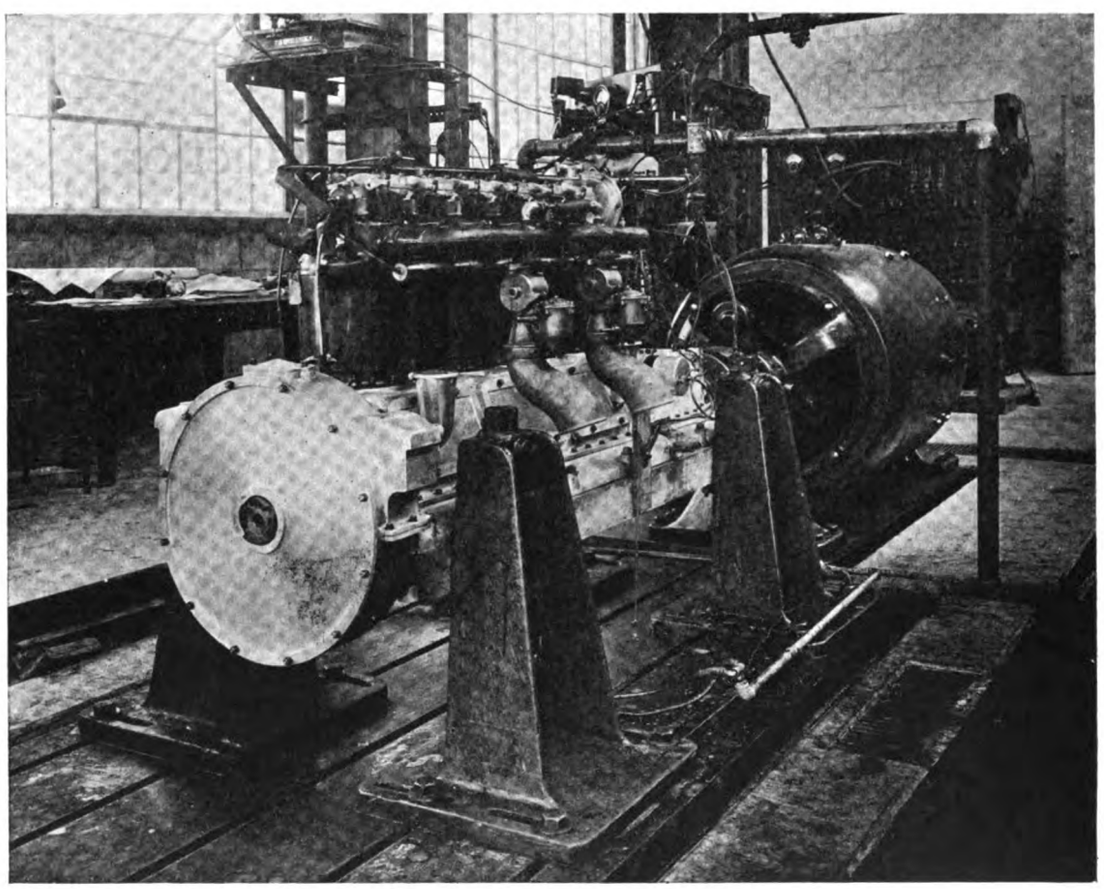
Experimental and Research Laboratory of the Hall-Scott Motor Car Company

By RICHARD VOSBRINK*

From an insignificant beginning some fifteen years ago the aeroplane and aeroplane-engine industry has developed into a recognized and important branch of the automotive art. The technology of aeroplane engine design, however, has not been brought to a high plane as yet, partly because of the infancy of the industry, but more largely because of adherence to traditions and precedents established in other branches of the automotive field. A large amount of research work, both pure and applied, is still to be undertaken. Investigations into the characteristics of engines, planes, and flight are of prime importaance, because of the present lack of accurate data.

The industry is still empirical in practice. The installation of laboratories and the acquisition of technical staffs has aided greatly in putting this phase of the industry on a more rational basis. The national importance of the aeroplane urgently requires investigations for the purpose of improving and developing both the engines and planes as well as allied details. In an endeavor to aid in proving and correlating such valuable facts and such developments as might occur, as well as to discover remedies, to prove theories, and to ascertain causes, etc., it is obvious that thorough means of conducting investigations and experiments must be employed together with the use of such apparatus as will measure, record, and otherwise indicate and preserve the results obtained during a period of investigation.



GENERAL VIEW OF DYNAMOMETER, SHOWING ENGINE READY FOR TESTING

With this purpose in view the Hall-Scott Motor Car Co. has erected at its factory at Berkeley, California, an electrical-dynamometer laboratory, which, completely equipped with apparatus and instruments, cost approximately $50,000. This laboratory, when completed, contained the largest electrical dynamometer west of Cleveland, and was the only laboratory of its kind on the Pacific Coast at that time.

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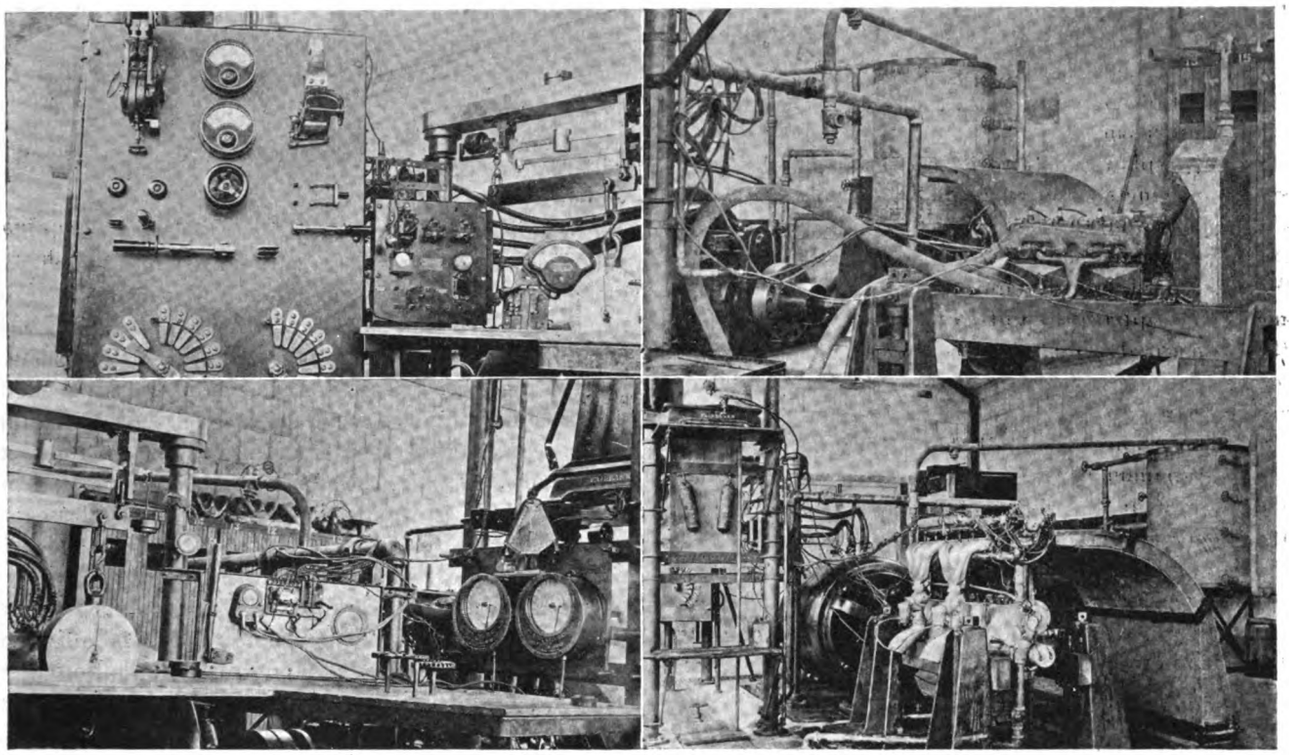
The laboratory building was designed and built especially for the purpose of housing the equipment. It is of reinforced-concrete and hollow-tile construction with armored-glass windows and ventilating-hatches in the saw-toothed roof. It is fireproof, no wood or inflammable materials being used whatever.

A unique feature of this laboratory is that the floor-plan was so arranged that with all the equipment in place, there are no air, oil, water, gasoline, or exhaust-pipes or wiring conduits laid on top of the floor or suspended overhead. Large channels or ditches were built into the concrete floor to accommodate all piping, wire, and connections. These channels are open and covered with cast-iron gratings, which can be removed for inspection and re-arrangement of piping and wiring. This plan gives the laboratory a neat and pleasing appearance.

The electric dynamometer is used for testing high-speed engines such as are used in automobiles, trucks, tractors, and aeroplanes. It is primarily an absorption-brake for measuring the horse-power delivered by an engine, but has also many other applications and is equally able to measure the torque delivered, which with the speed gives the brake horse-power. It affords a simple means of measuring friction losses and thus the mechanical efficiency of an engine. Horse-power is the product of torque in foot-pounds and speed in revolutions per minute multiplied by a constant. The electric dynamometer measures the horse-power of an engine by indicating on a scale the torque delivered by the engine-shaft while a tacheometer on the shaft indicates the speed.

Horse-power tests are useful in the study of nearly every part of an engine. The effects and value of carburetion is shown by the results it produces in power per unit of fuel consumption and the power output of the engine at different speeds. The efficiency of an ignition system can be determined by power tests at varying speeds and load. Power tests will also show the efficiency of intake-manifold design, the effects of different kinds of exhaust manifolds and mufflers, the results of elimination of vibration by balancing the reciprocating elements of the engine, and the difference between various types of piston construction, materials, and piston-rings.



UPPER LEFT, DYNAMOMETER-CONTROL PANEL, SHOWING LOAD AND CONTROL SWITCHES, RHEOSTATS, THROW-OUT, STOP-WATCH, BELL-INDICATOR, AND ELECTRIC TACHEOMETER. LOWER LEFT, DIRECT-READING AND BEAM SCALES, PRESSURE-GAUGES, RECORDING THERMOMETER, RECORDING BAROMETER, THROTTLE-CONTROL, IGNITION-SWITCH, AND WATER AND GASOLINE SHUT-OFF HANDLES. UPPER RIGHT, TEMPERATURE WATER-CONTROL TANK AND VALVES. LOWER RIGHT, ENGINE UNDER TEST, SHOWING EXHAUSTS LEADING INTO CHANNEL-FLOOR, ALSO COOLING-TANK.

Of great importance also is the testing of various lubricating oils by studying the relative values under known conditions of speed and load. Another fruitful field for investigation is the effect of different compression pressures and temperatures in connection with different kinds and proportions of fuel. In fact, practically all the characteristics of an engine can be investigated, noted, and recorded for future reference, such as: revolutions per minute, and torque, brake mean effective pressure, friction horse-power, indicated horse-power, mechanical efficiency, thermal and volumetric efficiency, inlet jacket-water temperatures, outlet-water temperatures, consump-

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tion of fuel in pounds and gallons, and per horse-power, measured in units of time; flow of water in pounds and gallons per unit of time, velocity of gases, oil temperatures, effects of excess of gas, effects of speed on efficiency, effects of throttling, effects of piston velocity and inertia forces, expansion-curves, exhaust-losses, scavenging, determining clearances, bearing-pressures and structural stresses.

The field for investigation and experiments is unlimited. Of course it must be understood that the value of the results will be proportional to the understanding of the phenomena observed and the application of the knowledge gained, correlated in such a way as to be useful for a particular problem. By making observations, compiling accurate data, and correlating the results, a great many valuable determinations can be made that would otherwise be secured only by arbitrary experimentation, which would of course relegate the science back into the field of empiricism.

Detailed explanations of the operation of the equipment and the method pursued in carrying out the desired investigation would necessitate an analysis illustrated with charts, graphs, and elaborate calculations, which if fully elucidated would require a volume to contain it. Some of the apparatus and instruments used are herewith enumerated, which together with the photographs gives an accurate conception of the extent of the laboratory facilities.

The main element is the 400-hp. Sprague electric absorption dynamometer. This apparatus is a direct-current generator and, as the company buys alternating current, an alternating-current converter is required. This equipment is large enough to measure the maximum friction horse-power of any engine that can be tested on the dynamometer. It is a 90-kw. synchronous converter. Both these instruments were furnished by the General Electric Co. A Fairbanks-Morse 5-kw. motor-generator set is used for excitation. The other electric devices include an exhaust-blower, a fuel-weighing and registering scale, a tacheometer, a direct-reading and beam scale, a revolution-counter, and a battery of absorption grids, together with control-panels and switch-boards. In addition to these there are numerous accessories such as Venturi meters for measuring the velocity and flow of water, air, and exhaust gases, vacuum-gauges for intake-manifolds, thermometers for intake-manifolds, and for oil and water temperatures, room-thermometers, room-barometers and hygrometers, as well as recording thermometers for oil and water temperatures, and a recording barometer and hygrometer; gas-tanks, automatic-scales, pressure-gauges, manograph, gas-analysis apparatus, and water circulation, temperature-control, and other similar apparatus.

The room is also fitted with lockers, benches, cabinets, blackboards, vises, a sensitive drill press, lathe, grinder, and other tools for making controls, attachments, and other apparatus to use when conducting a test. In fact, the entire equipment is complete and extensive enough to carry on any research work that the company may require.

Glasses for Protecting the Eyes From Injurious Radiators

The Bureau of Standards has issued Technological Paper No. 93, with the above title, by W. W. Coblentz and W. B. Emerson. The paper contains a brief discussion of the pathological effects of such radiations upon the eye, with particular reference to the infra-red and ultra-violet rays. The paper also considers the properties of the principal types of protective glasses. The following conclusions are given.

For protecting the eye from ultra-violet light, black, amber, green, greenish-yellow, and red glasses are efficient. Spectacles made of white crown-glass afford some protection from the extreme ultra-violet rays which come from mercury-in-quartz lamps and from electric arcs between iron, copper, or carbon. The vapors from these arcs emit but little infra-red radiation in comparison with the amount emitted in the visible and in the ultra-violet.

For shielding the eye from infra-red rays, deep-black, yellowish-green, sage-green, gold-plated, and bluish-green glasses are the most serviceable. For working near furnaces of molten iron or glass if considerable light is needed a light bluish-green or sage-green glass is efficient in obstructing the infra-red rays. For working molten quartz, operating oxy-acetylene or electric welding apparatus, searchlights, or other intense sources of light, it is important to wear the darkest glasses one can use, whether black, green (including gold-plated glasses), or yellowish-green, in order to obstruct not only the infra-red but also the visible and the ultra-violet rays.

One can easily decide upon the kind of glasses to use to protect the eye from the visible rays. The question is not so easily settled concerning the elimination of the ultra-violet and the infra-red rays. The data presented in the paper give some clue as to what can be accomplished in eliminating the infra-red rays. Data are given showing that of the infra-red rays emitted by a furnace heated to 1000 to 1100°C (1) about 99% are obstructed by gold-plated glasses, (2) about 95% by sage-green or bluish-green glasses, (3) about 60 to 80% by very deep-black glasses, and (4) about 60% by greenish-yellow glasses. The dark shades of the new 'Noviwelds' absorb 95 to 99% of the infra-red. At higher temperatures these figures would be somewhat different, but not sufficiently so to modify the rough estimates dealt with in this paper.

THE pupils in the various schools of San Diego had been vaccinated, and when each boy had been attended to, the doctor gave him a red ribbon bearing the words 'I have been vaccinated' to wear on his coat sleeve.

One lad proceeded to adjust the ribbon to his arm.

"You're putting it on the wrong arm," said the physician.

"No, I'm not," said the wise youth. 'You don't know the boys at our school."—'Los Angeles Times.

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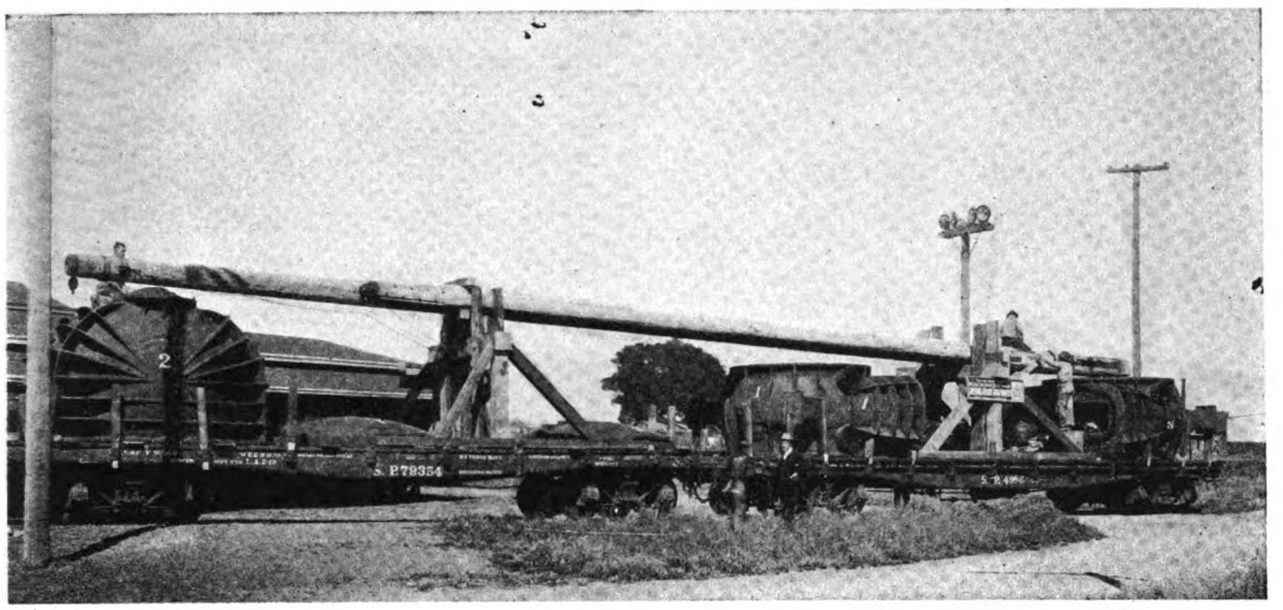

FIG. 2. VALVE LOADED FOR SHIPMENT

Some Large Gate-Valves Made at the Hendy Plant

The accompanying illustrations show some 8-ft. gate-valves recently made by the Joshua Hendy Iron Works at Sunnyvale for the San Joaquin Light & Power Corporation for its new plant on the San Joaquin river near Auberry, Fresno county. There were three valves in all, each 29 ft. 8 in. high overall, and weighing about 30 tons apiece. They were designed for a 68-ft. head of water. The valve-stem is operated by a 20-hp. motor, not shown in the illustrations, but which is set on the bracket adjoining the operating platform. The operating mechanism is designed to open or to close the valve in two minutes. Auxiliary apparatus is provided for operating the valve by hand in case of failure of the current or motor. The valve is provided with a 12-in. bypass, also electrically operated, a 1-hp. motor being used for this purpose. The thickness of the valve is 5 ft. 8 in. face to face.

Fig. 1 shows two valves connected for testing, in this way eliminating the need of one blind flange. The third valve was tested by the use of blind flanges. The test-pressure was 55 lb. per square inch, or twice the working-pressure. At this pressure no leakage could be found. Fig. 2 shows a valve loaded for shipment, together with the gin-pole and tackle used in taking it down, which was shipped with the valve to be used for assembling at the power-plant.

Each valve comprised, besides a number of smaller parts, three principal castings, the base or lower body, the upper body, and the column for the stem. The heaviest casting, the base, weighed 9¾ tons. These castings were of semi-steel, about 16% steel scrap being used with the cupola-charge. The proportion of pig and cast-iron scrap was varied according to the character of the material available. The castings were bored and faced in one operation, the base being machined on a 16-ft. Betts vertical boring-mill and the upper body on an 8-ft. Landis mill. The stem was a steel forging 6 in. diam. with a double Acme thread. The worm-wheel for operating the stem is of cast-iron and the worm of bronze. The power-plant, which is named after William G. Kerchoff, president of the company, was placed in operation August 15.

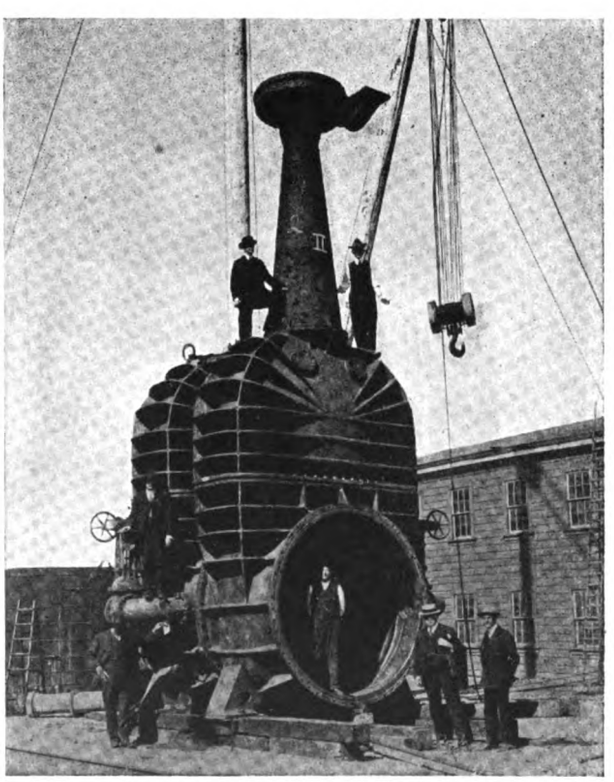

FIG. 1. VALVES READY FOR TESTING

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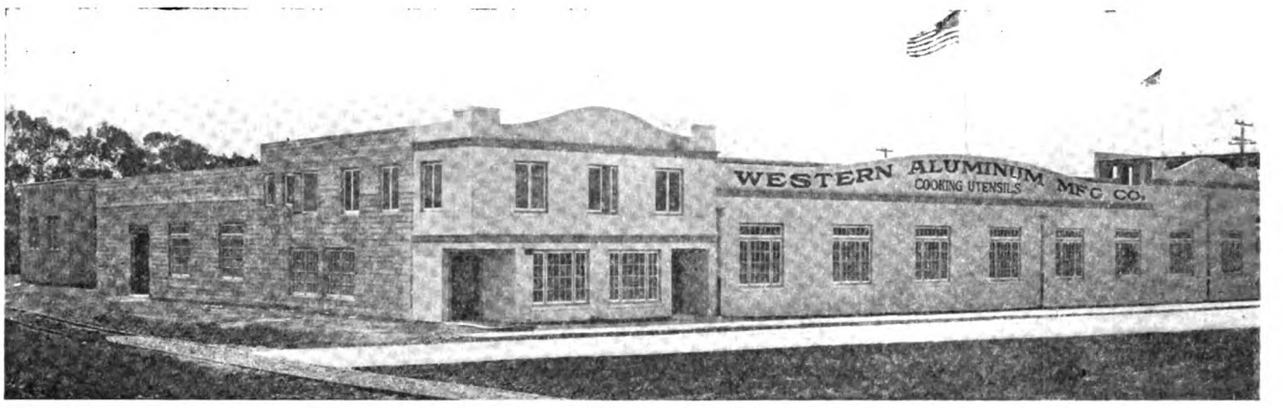

VIEW OF PLANT, FOUNDRY AT EXTREME LEFT

Casting Aluminum at the Foundry of the Western Aluminum Manufacturing Company

Besides its plant now being equipped for the manufacture of cooking-utensils from sheet aluminum, the Western Aluminum Manufacturing Co., of Emeryville, has in operation a foundry, where cast-aluminum ware is made as well as jobbing work. This is the first, and at the present time, the only jobbing foundry in the district exclusively devoted to aluminum.

The foundry building is a well-lighted corrugated-iron and wood-frame structure, 30 by 90 ft., adjoining the main building, but separated from it by a roadway space.

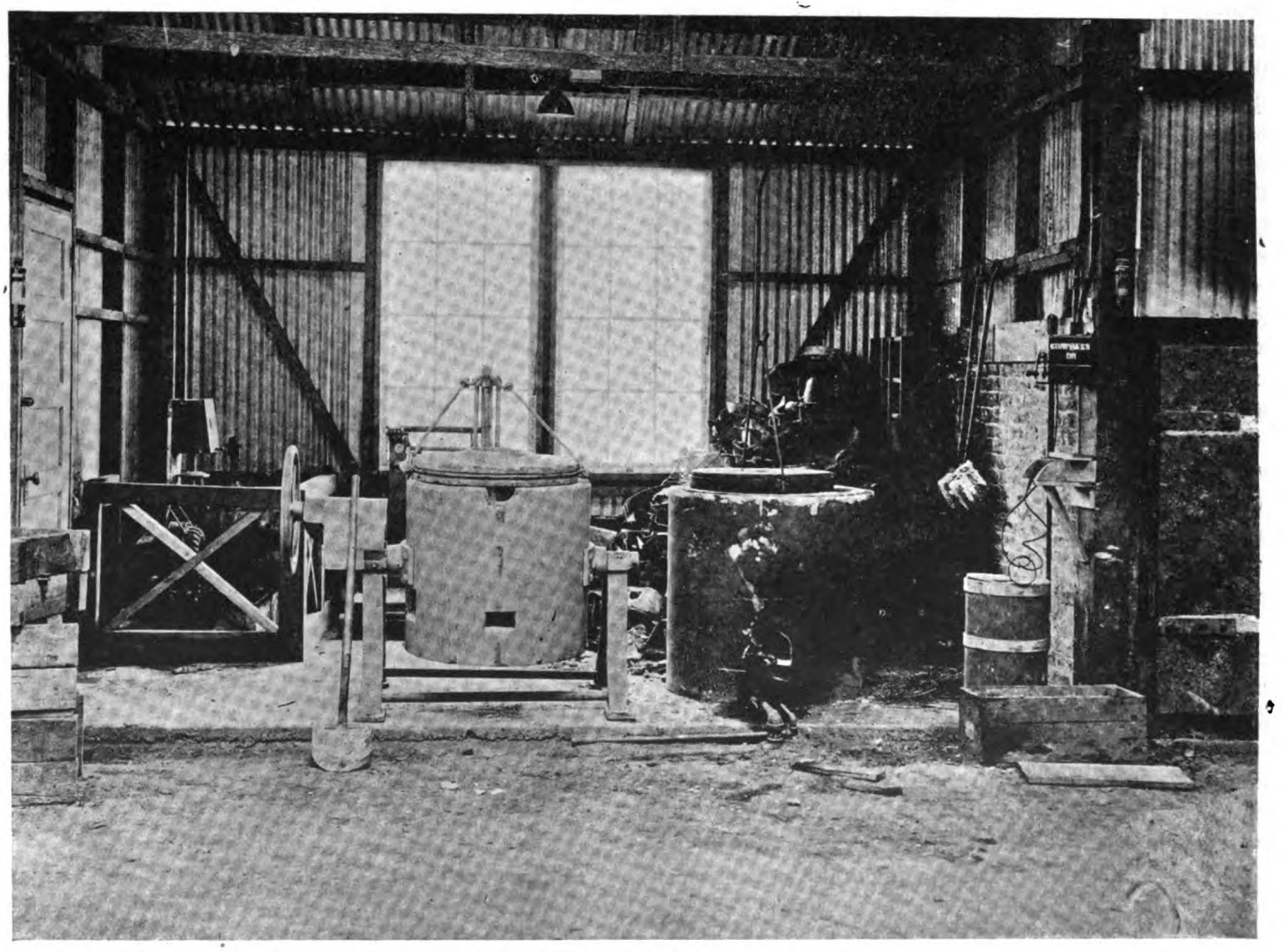

FIG. 1. INTERIOR OF FOUNDRY SHOWING FURNACE EQUIPMENT

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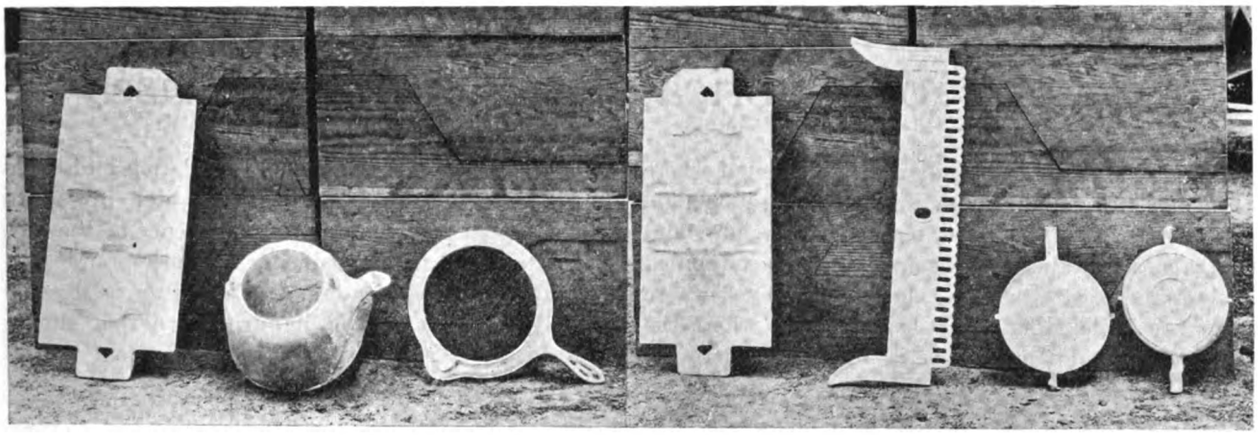

FIG. 2. MISCELLANEOUS CAST-ALUMINUM ARTICLES

On account of increased business, arrangements have just been made for doubling the size and capacity of the foundry. A spur-track and individual siding permits delivery of material without re-handling, while a paved street facilitates transportation. The furnace equipment is shown in Fig. 1. It consists of a tilting crucible-furnace manufactured by the Monarch Engineering & Manufacturing Co., of Baltimore, and a stationary crucible-furnace, constructed under the direction of the foundry superintendent, Bernard Lacoste. Mr. Lacoste is a foundryman of wide experience, who was for several years instructor at the California School of Mechanical Arts, usually known as the Lick School, in San Francisco. He has made a special study of casting aluminum, and there are few men that can equal him in knowledge of the peculiarities of that interesting metal.

Each furnace has a capacity of 150 to 200 lb., or a volume equivalent to 500 to 600 lb. of brass or iron. The furnaces are heated by S. T. Johnson oil-burning equipment, driven by a 2-hp. Westinghouse motor. Accurate temperature control is ensured by the use of a Hoskins pyrometer. At one end of the shop is a battery of four No. 7 grinding and buffing wheels, manufactured by Chas. F. L'Hommedieu & Sons, and each with individual-motor drive. These are used for finishing kitchenware and other castings. The equipment also includes a larger grinder and buffer, a Crescent band-saw, and a Westcott drill.

Fig. 2 shows some of the cooking-utensils cast at the foundry, a teakettle and the several parts of a waffle-iron. A large part of the jobbing work done is the making of aluminum patterns, of which the match-pattern in the illustration is a good example. Both sides of the pattern are shown. An ornamental plate made for a firm manufacturing electric heaters is also shown. None of these castings required an appreciable amount of smoothing or finishing, but are practically as taken from the sand.

For molding, San Diego sand is used. This is extremely fine, being practically a silt. On account of the relatively low casting temperature, the sand does not 'burn up', and can be used over and over again almost indefinitely. For thin castings, 98% pure ingot aluminum is used. Where the castings are thicker, and a higher tensile strength is required, the No. 12 alloy, containing 8% copper, is preferred. Intermediate cases call for varying proportions of the two. Pouring temperatures range from 1350° to 1600°F., according to the thickness of the metal in the casting.

The arrangement of gates and risers, together with the pouring, for aluminum castings calls for special study, and ordinary brass-foundry experience is of comparatively little assistance to the foundryman because of the difference in the properties of the metal, particularly the weight. Also, if the foundryman attempts to 'doctor' an inferior surface with acid, while it may look all right for a while, unsightly blotches are likely to develop in a week or so, a serious disadvantage for aluminum, where appearance is usually an essential requisite.

Artificial Graphite

Graphite is manufactured by the Acheson Graphite Co. at Niagara Falls, New York. This company utilizes the electric power generated at the Falls to manufacture graphite from anthracite or from petroleum coke. This product is used mainly in lubricants, but it is also used in paints, foundry-facing, preventives of boiler-scale, and fillers for batteries.

Artificial graphite may be used for any purpose for which natural graphite is employed, according to the U. S. Geological Survey, except in the manufacture of large crucibles. Patents have been issued recently, however, for methods of manufacturing crucibles in which artificial graphite may be used. Artificial graphite is peculiarly adapted to the manufacture of certain graphite products, among them graphite electrodes, which are not made from natural graphite and for which the demand has greatly increased in recent years. The table below, published by permission of the Acheson Graphite Co., represents only the manufactured graphite that comes into competition with natural graphite.

Graphite Manufactured by the Acheson Graphite Co., 1915-1919

	Pounds
1915	5,084,000
1916	8,397,281
1917	10,474,649
1918	9,182,272
1919	8,163,177

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Selection of Lubricating Oils and Greases*

Light-bodied, quick-acting oils must be selected where the bearings are small, where the shaft-speed is high, where the bearing pressure or temperature is low, and where the mechanical conditions are good. Heavy-bodied oils possessing great 'sticktion' must be employed where bearings are large, where shaft-speed is low, where the bearing pressure or temperature is high, and where the mechanical conditions are not good.

The oil must also be selected to suit the system employed. Hand-oiled bearings are rarely completely lubricated; they are usually only partly lubricated and demand the use of heavier bodied oils than would be required with a more efficient oiling system. A great deal of oil is wasted by this method.

The kind of oil to use depends largely on the lubricating system.

In drop-feed oiled bearings less oil is wasted than in hand-oiled bearings and, because of the better regulation of the feed of a medium or heavy bodied oil, the oil film in the bearings is kept more nearly uniform and complete. The lubrication is, therefore, more efficient, that is, there is less friction and less wear.

By the ring-oiling system the bearing surfaces, when operating, are constantly flooded with oil, so that the lubrication is as efficient as possible with the grade of oil in use.

For splash-oiling systems oil should be light in body so as to splash easily to all parts, yet sufficiently heavy in body to produce complete lubrication. It is important to maintain a correct oil-level as constantly as possible. If the oil-level is too low, too little oil spray will be formed and some of the parts will be 'starved'. Inefficient lubrication will follow. If the oil-level is too high, too much oil spray will be formed. This causes waste of oil. The oil spray will escape from the bearings or from the air-vent usually provided in the crank-chamber.

In automobile, motor-cycle, and other industrial internal-combustion engines, excessive oil spray is positively detrimental, producing deposits on the hot pistons.

In vertical enclosed-type steam-engines, the presence of excessive oil spray means that too much oil passes the pistons and finds it way through the engine with the exhaust steam. This means waste and frequently causes trouble where it is important that the exhaust steam should be as free from oil as possible.

As the oil in a circulating system is forced in large quantities to the bearings, the oil is given every assistance to produce complete and correct lubrication. The oil, however, must be of such a character as to maintain its nature, despite a continuous circulation and exposure to the 'breaking down' influence of high pressure and high temperature; the oxidizing influence of the air and impurities, and the emulsifying influence of water.

The oil must also be of such a character as to separate quickly from water and impurities, so that sludge or other deposits may be easily removed from the oil in circulation.

In the oil-circulating system a continuous and large supply of oil is delivered to the bearings. The frictional heat of the bearings is carried away by the oil so rapidly that it is possible to operate engines employing this system at the highest speeds, and yet maintain a sufficient margin of safety in operation.

To minimize the formation of deposits and other impurities from the oil when splash-oiling or oil-circulating systems are employed, it is good practice, depending on the size of the oiling system and severity of service, to draw off a certain amount of oil from the system each day for treatment, in a heated separating-tank and afterward in a suitable filter. The purified oil should be returned to the system, mixed with a little fresh oil, at the same time that a corresponding quantity of oil is removed for treatment.

Where there is a circulating system, a certain amount of oil should be drawn from the system each day for treatment in separating-tanks and filters. The purified oil should be returned to the system.

This practice is particularly desirable when the quantity of oil in use is small. In this way the quality of the oil is kept at as high a standard as possible, and its life is prolonged.

Occasionally, in large plants, the separation and filtration apparatus are constructed as a part of the oil-circulating system, so that either the whole of the oil in circulation or a certain proportion of it constantly passes through the treating apparatus.

Circulation-oils are specially treated to withstand the breaking-down effect of continued use under severe conditions of service. The oils best adapted to use in splash-oiling, ring-oiling, or oil-bath systems possess similar characteristics.

Where hand-oiling or drop-feed oiling systems are employed, the oil, after having once passed through the bearings, is frequently run to waste and not used over again. In such cases the slight alteration which takes place in the oil passing through the bearing is of little importance.

In other cases the oil after having once passed through the bearings is collected and filtered for further use, either on the same bearings or for less important work. For such purposes the oil must possess to a great degree the same characteristics as circulation-oils, particularly if it

*From 'Bearings and their Lubrication', issued by the Vacuum Oil Company.

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be used over and over again on important bearings with only a slight loss of oil.

Assuming that the oil is applied by a suitable oiling system and a complete oil film is formed, an oil too heavy in body will produce unnecessary high fluid-friction. It is not unusual to find that a number of bearings in a plant are being lubricated by an oil far too heavy, merely because a few other bearings, operating under bad mechanical conditions, demand its use. Better economy would be secured by using the heavy oil only on the few troublesome bearings. The greatest economy would be obtained by correcting the mechanical conditions so that the correct high-grade oil could be used throughout.

Many bearings of modern machinery, such as enclosed high-speed steam-engines, automobile-engines, and other enclosed high-speed internal-combustion engines, steam-turbines, and ring-oiled shaft-bearings, are lubricated by oiling systems in which the bearings are constantly supplied with a liberal amount of oil and complete lubrication is obtained, but oils too heavy in body are used. An oil too light in body, notwithstanding a liberal feed, will be unable to form and maintain a complete oil film. Excessive metallic friction and wear will result. An oil too heavy in body will not spread rapidly, causing frequently an incomplete oil film with resultant heating and wear.

When the correct high-grade oil is introduced, it will bring about a reduction in bearing temperatures, which will be shown by a reduction in the temperature of the oil in circulation.

From the foregoing it will be understood that, speaking generally, oils relatively heavy in body must be selected where hand-oiling or drop-oiling systems are employed. Oils relatively light in body may be selected where a more efficient oiling system is employed, such as ring-oiling, splash-oiling, oil-circulation, or oil-bath.

Use heavy-bodied oils where lubrication is by hand or by drop-feed, and light-bodied oils where other lubricating systems are employed.

Low-grade oils are ordinarily oils improperly manufactured. They lack uniformity, have high internal fluid-friction and many of them vary in viscosity under slight variation in temperature.

For the protection of their machinery, operators are compelled to use such oils extravagantly to ensure a constant adequate oil supply to all parts of the bearing surfaces.

When low-grade oils are used, applied by hand-oiling or drop-feed oiling, wear cannot be prevented entirely, notwithstanding a liberal oil feed.

When using low-grade oils in ring-oiling, splash-oiling, oil-circulation or oil-bath systems, the oil breaks down under the continuous service, and exposure to the effects of air, high temperature, water, and impurities. The oil has a comparatively short life, and develops troublesome deposits, which accumulate in dangerous places, and choke oil-pipes, oil-channels, and grooves. The bearings are thus deprived of full lubrication.

Low-grade oils compounded with unsuitable fixed oils will oxidize quickly and cause gummy or sticky deposits. The occurrence of such deposits means that bearing friction is slowly but surely on the increase and in time acute trouble may occur.

Unsuitable oils, when used in ball or roller bearings, will cause corrosion of the balls and rollers, or may oxidize and gum, thus forming a base for dirt, deposit, and trouble.

High-grade oils are manufactured from specially selected crudes, carefully refined and treated with the object of giving each oil definite and uniformly maintained characteristics. They have low internal fluid-friction and vary considerably less in viscosity under slight variations in temperature than low-grade oils. Because of this fact high-grade oils can be used more economically than low-grade oils.

The correct high-grade oil, applied by hand-oiling or drop-feed oiling, will largely reduce or entirely prevent wear, even with a scantier oil feed than is possible with an ordinary oil.

The correct high-grade oil, applied by ring-oiling, splash oiling, oil-circulating, or oil-bath systems, will have a much longer life than ordinary oil. It will not develop deposits during use, and will separate easily and quickly from water and impurities that may enter the system.

When comparing the results from the use of an ordinary oil with those of a high-grade oil, both of the same viscosity, experience proves that the high-grade oil will possess greater 'sticktion' and endurance and will sustain greater bearing pressures. Therefore, a high-grade oil that possesses a lower viscosity than an ordinary oil can be used for a given set of operating conditions and yet will maintain a complete lubricating film and safeguard against wear.

In cup-greases, the difference in melting-point between the soft grease (No. 1 consistence) and a hard grease (No. 5 consistence) is comparatively small, namely 12° to 15°F. Soft light-bodied greases contain more lubricating-oil than heavier-bodied greases. In other words, a grease of soft consistence contains more oil per pound than a harder or denser grease. The soft grease begins to lubricate almost the instant it is applied to the bearing, whereas a harder or denser grease does not begin to lubricate until the bearing temperature becomes sufficiently high to soften the grease.

The efficiency of a grease depends upon the following:

First: The quality of the fat employed in the manufacture of the body and the quality of the oil incorporated in the finished grease.

Second: The selection of the correct density or consistence to suit the type of bearing and method of application.

Third: The purity of the grease, particularly the absence of dirt, improperly manufactured body, and foreign substances sometimes used as a cheapener.

The quality of the grease depends first upon the selection of high-grade fats and lubricating oils; and, sec-

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ond, upon the care employed in the manufacturing processes to make a grease that will meet specific operating conditions.

For medium and high-speed work with no excessive bearing pressure a grease of soft density containing light-bodied lubricating oil should be chosen. For medium and slow-speed work with fairly heavy bearing pressure a medium to hard-density grease containing heavier bodied oils should be chosen.

The type of the feeding devices determine, to a large extent, the consistence of the grease to be used. If the grease is fed through an automatic-spring grease-cup it should be of soft consistence, No. 1 or No. 2. These same consistences are recommended for high-speed ball and roller bearings. For hand-compression grease-cups consistences No. 2, No. 3, and No. 4 may be employed. Care should be taken to see that in all instances the grease is of a density that will feed easily and without waste. A grease of No. 4 or No. 5 consistence may be selected for use on open bearings where the grease rests directly on the rotating shaft. This condition is usually found only in slow speeds.

The type of the feeding devices determine, to a large extent, the consistence of the grease to be used.

Demand for Sugar Machinery in India

By W. H. RASTALL*

The demand in India for all kinds of machinery used in the production and refining of sugar will probably increase rapidly in the near future. Recent years have shown the need of improving the yield and the methods of manufacture. India has long been an important producer of sugar cane, having an acreage (about 2,500,000) larger than any other country in the world. But the yield per acre has been low, averaging 2754 pounds of cane per acre in 1916-'17. The demand from its 315,000,000 inhabitants has been large, necessitating the importation of over 500,000 tons per year.

A committee has been investigating this subject and in the course of its work has visited practically all of the important districts of India. The report will probably be published in 1921 and will consider the use of small mills and comparatively primitive methods, as well as large plantations and modern centrals. Until a few years ago cane was grown and crushed by primitive methods. For some time better methods have prevailed, to the extent of using mills with iron rollers instead of the wooden charki of earlier days. This advance encourages the hope of the possibility of further improvement.

Among those who are considering the problem are people advocating the use of mills capable of caring for about 100 acres of cane. Apparently they have in mind a three-roller mill driven by an oil-engine, which would be used for driving an irrigation-pump when not needed for crushing. So large is the country that the universal adoption of such plants would involve the investment of about $100,000,000 (at pre-war values and exchange, but probably double that amount now). If irrigation and other items are considered, the investment would probably be three times as great. If this could be accomplished, it would be one of the greatest blessings India has ever experienced. Where the small power-driven mills have replaced bullock-driven mills they have increased the value of the product from a given area by about 25%. Others think that a plant to handle from 100 to 300 tons of cane per day is the most feasible type of equipment. Manufacturers will at once recognize the class of machinery needed for such work. Difficulties resulting from the land-tenure system of India emphasize the need of giving attention to these and to the smaller plants. In most of the territory it would be difficult to control a sufficient area to keep such mills operating. It would also be difficult to persuade the conservative Hindoo farmer to grow the kind of cane wanted in a modern way, so as to get results comparable with those of other countries. But India is a vast country, and there are districts still to be reclaimed from the jungle that can be secured and converted into modern sugar plantations, supporting centrals having capacity of over 1000 tons of cane per day. Several projects of this sort are being considered.

At present most of the cane is used in producing 'gur', a sort of native product, which, in other countries, is called 'black sugar' or 'molassuite', obtained by working the sugar and molasses down together. Present importations are largely soft, brown, or white sugars, mainly from Java. Where new plants are installed, with capacity sufficient to justify it, there will probably be a demand for apparatus suited to the production of white sugars. In some localities the carbonization process will probably be used. In other localities, where lime and limestone are not conveniently available, the sulphurization process will be preferred.

There will be an important demand in India for every type of sugar machinery, and persons going there to solicit business will find among prospective buyers great diversity of ideas as to what should be done. Probably each will be found to have plans that are suited to the peculiarities of his own district.

*Trade Commissioner, Bureau of Foreign and Domestic Commerce.

First Gas-Locomotive in Europe

According to information received at the American Red Cross headquarters in Paris, the first gasoline-driven railway locomotive ever seen in Europe has just been put in operation on a Spanish line, making the run between Armagesilla and Fonselloso.

The locomotive is of American make. It weighs 30 tons, develops a tractive power of 200 tons, has six drivers, and ran 80 miles an hour on its speed-tests.

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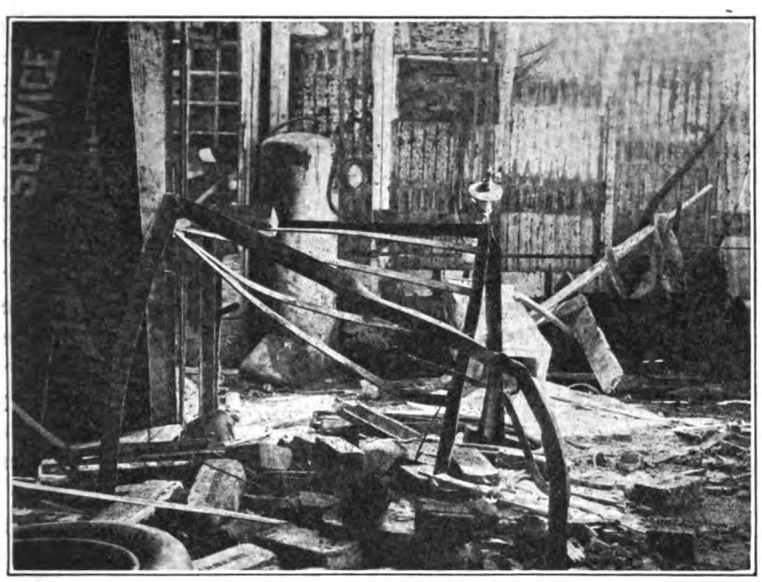
Explosion of Acetylene and Oxygen Cylinders*

By R. L. HEMINGWAY

Early in April last, a battery man in a Californian garage wanted to obtain some oxygen for use with the burner that is commonly employed in burning automobile-battery leads. To accomplish this, a newly received cylinder of oxygen was set in the workshop alongside the welding-bench and a connection made by means of a piece of copper pipe with a union at each end, to an ordinary acetylene-tank about 6 in. diam. by 24 in. long. This acetylene-tank was of the standard type, constructed for a working-pressure of 250 lb. per square inch at 70°F. Oxygen-cylinders, as received from the charging-stations, usually contain gas at 1800 lb. pressure per square inch at that temperature. The result, as might have been expected, was a terrific explosion, which blew the battery-man literally to smithereens, wrecked one end of the garage, and started a fire. An unfortunate patron, who was standing forty or fifty feet away in the garage, was also killed by being struck on the head by a flying fragment of the oxygen-cylinder.



SCENE OF THE EXPLOSION SHOWING THE WRECKED WELDING-TABLE

The Industrial Accident Commission, in the course of an investigation of this explosion, found two former employees of this garage, who testified that they had been instructed by their employer to take oxygen out of the high-pressure cylinders and put it in the acetylene-tank for convenience in use at the battery-bench. It is not definitely known that the dead employee had received these instructions, but it seems a natural conclusion, in view of the facts stated above.

Many of our readers will remember a series of three explosions with numerous fatalities that occurred in California four or five years ago, when it was conclusively proved that the gas contained in the exploded cylinders was not pure oxygen, but was a mixture of oxygen and hydrogen, manufactured by what is known as the electrolytic process, that is, the process of resolving water into its component gases by means of an electric current and collecting the gases as they are given off at the positive and negative electrodes. In this process there is always the possibility of a reversal of current, causing the hydrogen to be delivered at the pole that was formerly delivering the oxygen, unless the installation is protected by modern mechanical and electrical equipment. As a matter of fact, analysis of samples taken from cylinders charged at the same time as the exploded cylinders showed that these contained a dangerous admixture of oxygen and hydrogen.

Experiments have shown that upward of 10% of hydrogen is required to be present in oxygen before there is any serious liability to explosion, but a standard has been set by the Underwriters' Laboratories limiting the hydrogen impurity to 1%. In this particular explosion, the investigation proved conclusively from precautions used by the manufacturer and from analyses of samples taken from other cylinders that were charged at the same time, that the impurity of hydrogen in no case exceeded 0.4%, so that there does not seem to be any possibility of this explosion having been caused by hydrogen. What actually took place, apparently, was this: Oxygen at 1800 lb. pressure was turned directly into the acetylene tank, which had been tested only to 500 lb. per square inch as required by Interstate Commerce Commission specifications for acetylene-cylinders. The acetylene tank stretched, due to the excessive pressure creating free spaces around the porous filler, in which the free acetone vapor and acetylene mixed with the oxygen, naturally causing an explosion of this highly inflammable mixture, as is proven by an examination of the fragments. For example, the bottom-head, which had formerly been convex to pressure was found concave to pressure and ruptured around almost its entire perimeter.

Fragments of the acetylene-tank were picked up over a large radius and one piece was found driven clear through a 2 by 6-in. wooden roof-girder. Since the walls of the oxygen-cylinder were under an internal stress of 1800 lb. per square inch, it can readily be realized that the violent concussion caused by the explosion of the acetylene-cylinder, coupled with possibly a short sharp

*From 'California Safety News', published by the Safety Department, Industrial Accident Commission of California.

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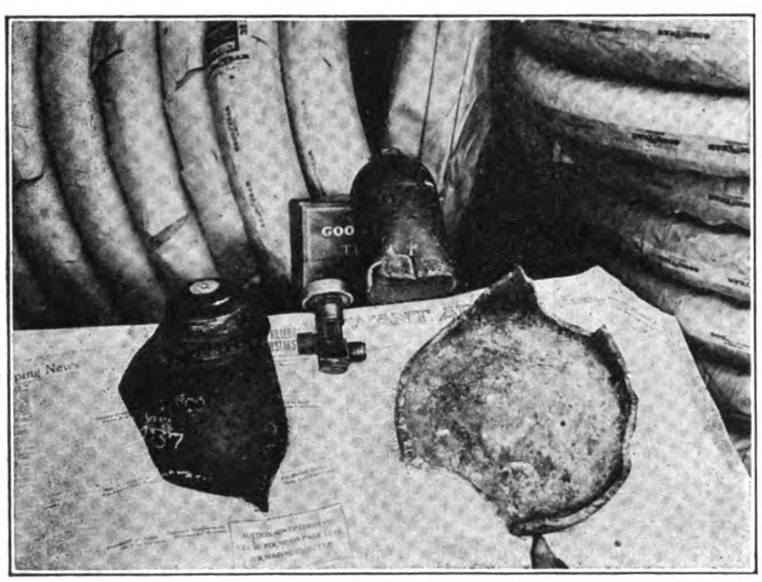
blow from a flying fragment of this cylinder, induced such excessive vibrations in the oxygen-cylinder as to cause it also to explode. Apparently, this is what took place, the two explosions occurring so close together that they gave the impression of being simultaneous.

In commenting on the report sent to him, B. W. Dunne, chief inspector for the Bureau of Explosives, writes as follows: "Upon reading the preliminary statement issued by the Industrial Accident Commission, I can only say that an explosion of this character was to have been expected. The amazing ignorance, and what I consider as criminal carelessness, existing in the plant of this garage in connection with the handling of these gases as indicated by the statement, is almost inconceivable."

Later, Mr. Dunne briefly stated the safety lesson that should be learned, in the following sentence: "Do not allow any person or company to charge cylinders with compressed gas under a pressure exceeding 25 lb. per square inch, unless that person or company has demonstrated his knowledge and ability of conducting such charging under reasonable conditions of safety.



GATE-VALVE, HEAD, AND BASE OF THE EXPLODED CYLINDER

"I might add as a further precaution, that under no circumstances should any person or company attempt to transfer a gas from one pressure-cylinder or container to another, irrespective of the nature of the gas. And that also under no circumstances should an inflammable gas be permitted in a container with oxygen gas even under no pressure."

It is earnestly hoped that all who may read this account will not fail to carry this gospel wherever they may find persons using gases under such high pressures as the convenience of transportation demands. The enormous increase in the use of gases for welding purposes, by persons that are not thoroughly conversant with the hazards, is sufficient excuse for giving a man a friendly warning.

One other point not commonly known is that it is dangerous to use oil, grease, graphite or any other hydrocarbon or inflammable substance on the valves, regulators, or other equipment in general use with oxygen. Oxygen under pressure in the presence of any of these substances is likely to cause spontaneous combustion at such a rapid rate as to have the effect of an explosion. The only safe lubricants are soap or soap-sud solution made from a non oil-base soap as Ivory soap or powdered soapstone or talc.

Shortage of Pig-Iron in Scotland

By WILBUR J. PAGE

Manufacturers in the iron and steel trades of Scotland could, with the orders that are on their books at the present time, use 40 to 50% more finished and semi-finished steel and foundry iron. The cause of this shortage is the scarcity of Scotch and Cleveland pig-iron.

Scotch pig-iron production is dependent on foreign hematite ores, brought largely from Spain as return cargo for boats that carry British coal to Spanish ports on the outward journey. The receipts of Spanish ore at Scottish ports have been increasing; but here, again, the Scottish iron trade is face to face with a new and somewhat serious problem, namely, a shortage of coal for export. The new allocation of export of coal by the Coal Control Board on the percentage bases reveals that already many collieries have exported, if not beyond their allocation, at least nearly that amount. This opens the prospect of having to send ore-carrying vessels to Spanish ports in ballast if the trade is to receive adequate supplies of hematite ores.

As a result of shortage of pig-iron in general, and foundry-iron in particular, the Scotch pig-iron makers are not now offering for export, the home demand being so heavy that they cannot attempt foreign business. Practically all the hematite iron or Scotch pig produced in Scotland is going straight into consumption.

On one of the press-boats, which recently carried a varied assortment of passengers for the first race between the 'Shamrock', Sir Thomas Lipton's challenger for the America's Cup, and the 'Resolute', America's defender, an officer of the American Red Cross, recently returned from Europe, had the good fortune of being one of the press representatives. This particular boat carried a number of 'big bugs', among them a well-known admiral and a well-known cartoonist. The Red Cross officer was lucky enough to hear the wit of the 'funny man' in scintillation.

The Admiral: "I tell you, the 'Resolute' is bound to win. She's capable of making fourteen knots an hour."

Cartoonist: "Say, Al, how much is that in American money?"

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A Pacific Coast Marine Diesel Engine

In the latter part of 1918, the Skandia-Pacific Oil Engine Co., of Oakland, decided to take up the manufacture of Diesel engines in addition to its line of semi-Diesels. After a considerable investigation, it was decided that, in place of developing an entirely new design, the rights for some established European engine would be acquired, thus taking advantage of the accumulated experience on the other side of the Atlantic. The Werkspoor engine was selected, and an agreement made with the parent company in Holland. The name, 'Werkspoor', by the way, is not the name of a man or a place, but is compounded from two Dutch words, and means 'power for work'.

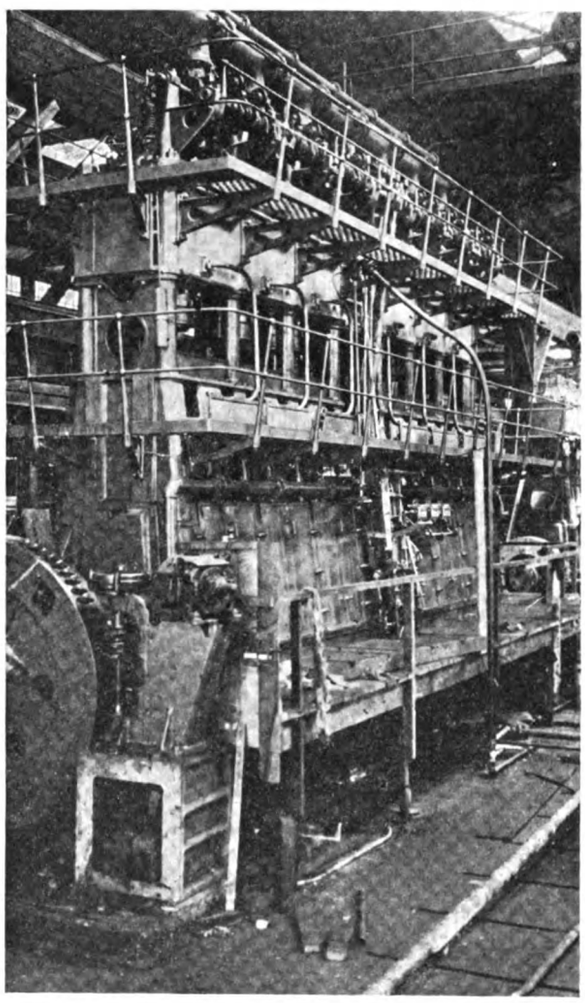
Besides the usual troubles incident to branching out into a relatively unfamiliar line, protracted strikes delayed the completion of the first engine until early in the spring of this year. On April 12, however, an exhaustive series of shop-tests was commenced on the completed engine, including a 30-day run at full load, followed by a ten-hour test at one-third overload, and several hours at various partial loads. The engine was then stopped purposely, although it could, apparently, have continued running indefinitely, and a series of maneuvering tests made.

This engine is a six-cylinder single-acting four-cycle Diesel engine, rated at 1100 indicated, and 825 brake horse-power, when operated at 135 r.p.m. The cylinders have a 20½-in. bore and a 35½-in. stroke. Two cylinder-blocks each carry a set of three cylinders, and are connected by an intermediate piece over the maneuvering-stand. The cylinder-block forms a water-jacket around the cylinders, and is supported by cast-iron frames on the crosshead guide-block and on the opposite guide-block columns, which are bolted to its under side. These and the guide-block are again supported by hollow cast-iron housings, which rest on and are bolted to the bed-plate. Solid steel tie-rods run from the top of the cylinder-block to the bottom of the bed-plate through the columns and housings.

The cylinder and cylinder-head are cast in one piece, which permits efficient water-cooling around the cylinder-top and valve-cages. This also eliminates the necessity for a gasket in the explosion-chamber, always a source of trouble. The lower part of the cylinder projects through the under side of the cylinder-beam and has a detachable skirt, permitting easy and rapid removal of the piston and piston-rings.

Between the cylinder-beam and the upper part of the cast-iron frames there is a cast-iron drip-tray running the entire length of the engine for collecting carbon and dirty oil from the cylinders, and all waste cooling-water, and preventing these and other undesirable substances from getting into the crank-case. The cages for the intake, exhaust, fuel, and starting-air valves are removable. The intake and exhaust valves are of cast-iron with steel stems, and are interchangeable.

For testing, the engine was set on the reinforced concrete floor of the assembling department, which is 5 ft. thick, and rests on the ordinary clay soil common to the vicinity of the Oakland estuary, where the Skandia plant is situated. Cast-iron benches were set upon the floor and the engine bolted to the benches. The design of the engine gives such rigidity, however, that even with this simple arrangement, the amount of vibration when the engine was running was negligible. Cooling-water was circulated by two 4-in. motor-driven centrifugal pumps, and lubricating-oil by two 2-in. motor-driven rotary pumps with a capacity of 60 gal. per minute. Fuel-oil was stored in an underground tank and delivered by a motor-driven pump. The air-compressor is placed at the forward end of the engine and is driven by an extension of the crank-shaft. The compressor is three-stage, the



SKANDIA WERKSPOOR ENGINE ON TESTING-BLOCK

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stroke of the cylinders being 15¾ in. and the bores, 16½, 8¼, and 3⅛ in., respectively.

While the main 30-day test was supposed to be conducted at 825 brake horse-power, actually the average brake horse-power for the first 15 days was 900, and for the remainder of the test, 850. This illustrates the conservative rating of the engines. The following figures show the principal statistical features of the main test:

Average indicated horse-power	1177
Average brake horse-power	877
Average mechanical efficiency, per cent	75.1
Average mean indicated pressure, pounds	195
Average mean effective pressure, pounds	99
Average temperature intake cooling-water, degrees Fahrenheit	62.5
Average temperature cylinder-jackets, degrees Fahrenheit	86 to 91.5
Average temperature pistons, degrees Fahrenheit	105 to 107
Average temperature engine-room during test, degrees Fahrenheit	60
Average temperature exhaust-gases, degrees Fahrenheit	500
Proportion of indicated horse-power compressor to indicated horse-power engine, per cent	3.93

The fuel used was Calol Diesel oil, supplied by the Standard Oil Co. The gravity was 24.5° Baume, the flash-point, 195°F., and the burning-point, 235°F. The b.t.u. value was 19,000 per pound. During the main test, the consumption of fuel-oil at full load was 0.453 lb. per brake horse-power hour. After the 30-day test, certain modifications, based on the experience gained, which are described later in this article, were made, as a result of which, the consumption was reduced to 0.423 lb. per brake horse-power hour at full load.

Calol Diesel heavy lubricating-oil, also supplied by the Standard Oil Co., was used for lubrication. This had a gravity of 19.3° Baume and a flash-point of 355°F. Allowance being made for the oil reclaimed by filtering, the net consumption per 24 hours was 6 gal. for the principal sight-feed lubricating system for the cylinders, ½ gal. for hand lubrication at various points, and 20 gal. to make up for losses from the crank-case. This crank-case oil was carried up into the bulkhead-pans by the piston rods. This leakage was caused by the fact that the piston-rod packing was simply a single turn of asbestos. This was done purposely in order that the pistons might work freely in the cylinders. A more efficient metallic packing now being substituted will probably reduce the amount of oil required to make up for crank-case loss to about 1 gal. per day.

The maximum thermal efficiency observed during the test was 31.5%, and the average 29.6%. The remainder of the heat delivered to the engine by the fuel was distributed as follows:

	%
Loss in cooling-water	23.7
Loss in exhaust-gases	20.4
Loss in friction and radiation	26.3
Total losses	70.4

Following the main 30-day test, two sets of tests were made at varying loads. In the first, the number of revolutions per minute was kept constant and the mean effective pressure varied. The fuel-consumption was as follows:

Brake horse-power	Pounds per brake horse-power hour
1000	0.423
917	0.452
837	0.472
606	0.466
404	0.522
211	0.632

Following this the mean effective pressure was kept constant and the number of revolutions per minute varied from 75 to 135. The fuel consumption was 0.439 lb. per brake horse-power hour at 135 revolutions, and 0.622 lb. at 75 revolutions per minute.

When the varying-load tests were completed, the engine was stopped and the maneuvering tests commenced. In the first set of tests, a two-stage compressor was connected with the maneuvering tanks, making it approximately equivalent to an auxiliary compressor on shipboard. Ten complete double manœuvers were made, from full-speed ahead to full-speed astern. Then the auxiliary compressor was disconnected and the tanks used alone. Starting with air at 300 lb., 36 complete reversals were made, the final pressure being 129 lb. At no time during the test was it necessary to re-charge the tanks.

After the regular tests had been completed, the burner-plate for the fuel was changed, the fuel-cams advanced, the muffler, which had caused some back-pressure, removed, and several minor changes made. As already noted, these changes effected a material improvement in the fuel economy.

Following the tests, the engine was dismantled and the parts examined. No part of the oil system was plugged, nor was there any sediment found except in the bottom of the service-tanks. The used lubricating-oil did not contain any polymerized hydrocarbons, tars, or other injurious substances derived from the oil itself, the only foreign matter found being sand, particles of cast-iron, carbon and graphite from the cast-iron, and babbitt. No perceptible wear on the journals could be observed. The bearings were slightly flattened. There was no wear or carbon deposit on either cylinders or pistons, with the exception of the No. 4 piston. About 2½ gal. of asphaltic tar was deposited in the bulkhead-pans every 24 hours. Probably all this material came from the fuel-oil. This material was caught on the pans separating the upper from the lower part of the engine and had no chance to drain into the crank-case, where it would have speedily interfered with the circulation of lubricating-oil.

Throughout the tests, the crank-case temperature was 2° or 3°F. lower than that of the lubricating-oil outlet, indicating that the mass of oil in the crank-case was responsible for transferring considerable heat from the pistons and bearing-pins. The circulation of a liberal amount of lubricating-oil is thus shown to be of advantage from the standpoint of cooling the engine as well as for lubrication. It was also found to be good practice during the test whenever the pistons began to work stiffly, to pump an extra amount of lubricating-oil until the condition was corrected.

Besides the service-tests as outlined, the engine also showed up well under the following unusual conditions:

1. An overload to 1100 b-hp. for ten hours, this taking place after the regular 30-day run, but without stopping the engine.

2. Operation for several minutes with no cooling-water except that standing in the cylinders.

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3. Operation for several minutes without lubricating-oil except that standing on the surfaces.

There appears to be no reason to doubt that we now have on the Pacific Coast a plant capable of manufacturing large Diesel engines, adapted to American conditions, and suitable for the ordinary ten or eleven knot freighter, and also as auxiliary engines for sailing vessels.

The first two 825-hp. engines are for service in the 5000-ton tanker, 'F. H. Hillman', being built by the Moore Shipbuilding Co. for the Standard Oil Co. Two 550-hp. engines of the same general design, one of which has been completed and the second is under construction, are to be placed in the tanker 'Charlie Watson', under construction by the Union Construction Co. also for the Standard Oil Co. The 'Charlie Watson' was launched on August 14.

Babbitts and Babbitting Methods*

By T. D. LYNCH†

A little more than 80 years ago, Isaac Babbitt, a goldsmith, of Taunton, Massachusetts, patented the then novel idea of using a soft lining-metal in journal-boxes, and holding it in place by proper anchorage. The best formula for this lining-metal was not settled by Mr. Babbitt nor has it yet been settled by later students of this subject.

Some authorities state that the formula used by him was: 88.9 tin, 7.4 antimony, 3.7 copper. The formulas in general and special use today, however, are so numerous and so varied that we cannot pick out either a tin-base or a lead-base alloy that may be considered as an American standard.

In 1918, Committee B-2 of the American Society for Testing Materials, made an attempt to tabulate the most practical compositions for tin-base and lead-base lining-metals for bearings, and the result of a compromise between the members of this committee is given in the following table:

A. S. T. M. babbitts—Specification B 23-18 T.

Alloy Grade No.	Tin, %	Antimony, %	Lead, %	Copper, %	Iron, %	Arsenic, %
1	91	4½	0.35*	4½	0.08	0.10
2	89	7½	0.35*	3½	0.08	0.10
3	83 1/3	8 1/3	0.35*	8 1/3	0.08	0.10
4	75	12	10	3	0.08	0.15
5	65	15	18	2	0.08	0.15
6	20	15	63½	1½	0.08	0.15
7	10	15	75	0.50*	...	0.20
8	5	15	80	0.50*	...	0.20
9	5	10	85	0.50*	...	0.20
10	2	15	83	0.50*	...	0.20
11	..	15	85	0.50*	...	0.25
12	..	10	90	0.50*	...	0.25

*Maximum.

Grades 1 to 5 are of the tin-base group and grades 7 to 12 are of the lead-base group. Agreement upon a standard composition for either group was impossible and most of the bearing-babbitts smelted probably do not correspond to any one of the 12 alloys selected by this committee.

From our experience with tin-base babbitts we have selected a composition between No. 2 and 3, having approximately 10 antimony and 5 copper, the remainder tin. This metal flows readily into linings 1/16 in. thick and lighter, while a higher copper content, such as No. 3 (a most excellent babbitt) tends to sluggishness when being poured, requiring thicker linings than 1/16 in. Likewise our experience with lead-base babbitts has caused the selection of a composition between No. 7 and 8, having approximately 14 antimony, 8 tin, with not over 5% copper, and the remainder lead, a metal that flows even more readily than the tin-base composition given above and performs well in service.

In 1913 I presented a paper before the American Society for Testing Materials, giving a series of tests on tin-base and lead-base babbitts, showing the development of the Brinell and Hammer tests, which we have found useful and which we continue to use at the laboratories of the Westinghouse Electric & Manufacturing Co. We have been agreeably surprised to know that the Brinell test is a good criterion for babbitt metal. It must be used, however, in connection with other known facts about the metal, namely, composition, methods of manufacture, etc., and at best it is only an arbitrary method of testing.

Every kettle of 3000 lb. of babbitt is given the Brinell test. This test consists of pouring a sample into a metal mold $\frac{3}{4}$ in. deep by $1\frac{1}{8}$ in. diam. at bottom and 2 in. diam. at top. The mold is preheated to approximately 40°C., by pouring preliminary samples to warm the mold. The Brinell impressions are made on the bottom-face of the test-piece as cast. This Brinell value for tin-base babbitt should be 30 to 38 with average of $34\frac{1}{2}$ and for lead-base babbitt 25 to 31. When a babbitt shows less than 24 Brinell hardness a wiping effect is observed, while the upper limits of Brinell hardness in lead-base babbitts must also be watched to avoid brittleness.

Successful babbitting must be thoughtfully and carefully done and any babbitt can be ruined by improper handling. The Westinghouse company has developed the following standard practice suitable for babbitting bearings with its lead-base babbitt, which is equally suitable for the tin-base babbitt.

Preliminary Machining of Shells

1. Boring of cast-iron, malleable-iron, and bronze shells.

Bore shells to dimensions given on drawings. Care must be observed to see that space is left so that the babbitt lining will be of uniform thickness and of the dimensions specified.

*Abstract from paper presented before the Association of Iron and Steel Electrical Engineers.

†Research engineer, Westinghouse Electric & Manufacturing Company.

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2. Preparation of pipe-shells.

Select pipe of proper diameter and thickness of section, cut it to the length specified, and face one end so that it will stand parallel with the babbitting mandrel to give the same thickness of babbitt at all points.

Cleaning of Shells

Clean shells thoroughly from all sand, scale, rust, oil, grease, etc. Remove sand by sand-blast or by pickling in hydro-fluoric solution. Remove scale or rust by sand-blast or by pickling in sulphuric-acid solution and remove oil or grease by burning it off before pickling in sulphuric-acid solution or remove it by dipping in caustic-soda solution.

All acid dips must be followed immediately with thorough washing in clean water.

Care of Tinning Alloy

Melt alloy No. 19 in an iron or steel pot, maintain the temperature of the metal in the pot between 410° and 440°C. The tinning alloy should not be heated above 450°C. If the pot is used only occasionally, cover the melted alloy with sawdust or charcoal to prevent the formation of dross. The metal must be stirred frequently when being used and always before using and after standing for any length of time in a molten condition.

Tinning of Bronze Shells

1. Bronze shells that are to be babbitted.

This tinning operation consists in coating the surface to be babbitted with a thin coat of alloy No. 19. Coat the machined parts that are not to be tinned with a thin mixture of graphite and water. When dry, swab parts to be tinned with zinc chloride, then dip into a pot of No. 19 alloy maintained at a temperature between 410° and 440°C. Leave the shell in the pot until it is just hot enough for the No. 19 alloy to run. Remove the shell from the pot and rub the surface to be tinned thoroughly with zinc chloride, making sure that all parts have a thin coating of the alloy and that no untinned spots are left on the surface to be babbitted. Immerse the shell again in the No. 19 alloy to remove the acid left from the swab and do not swab or otherwise touch the tinned surface again but babbitt immediately.

2. Bronze shells that are not to be babbitted.

Coat parts not to be tinned with a thin mixture of graphite and water. When dry, swab parts to be tinned with chloride, then dip into a pot of No. 19 alloy maintained at a temperature between 410° and 440°C. Leave the shell in the pot until it is just hot enough for the No. 19 alloy to run. Remove the shell from the pot and rub the surface to be tinned thoroughly with a swab saturated with zinc chloride, making sure that all parts have a thin coating of the alloy and that no untinned spots are left. Immerse the shell again in the No. 19 alloy to remove the acid left from the swab, after which clean with waste to remove any oxide or other foreign matter and brush the graphite from the untinned parts.

Tinning of Pipe Bearing-Shells

Pickle the shells made from steel pipe in sulphuric-acid solution for one to two hours, or until free from rust and scale, wash immediately in clean water, then dip into zinc chloride and finally into a pot of alloy No. 19, maintained at a temperature of 410° to 440°C., until the shell comes to the temperature of this alloy, remove the shell from the pot, brush off the excess alloy, and cool in water.

Coat the outside of shell with a red-clay wash, again dip the shell into alloy No. 19 until it comes to approximately the temperature of the alloy, remove it from pot and swab the bore with zinc chloride, dip again in alloy No. 19, do not swab or otherwise touch the tinned surface but babbitt immediately.

Anchor-Holes in Cast-Iron and Malleable-Iron Shells

All anchor holes should be cleaned well so that the babbitt is held firmly to the shell. (Cast-iron and malleable-iron shells are not tinned.) Standard anchor-holes should be generous in number and should be placed near the ends and at the edges of lubricating holes of all bearings in order to hold the babbitt firmly at the edges.

Sizes of Mandrel

1. Mandrels for solid bearings.

Mandrels for all solid bearings, both tinned and untinned, should be made with an allowance of 0.004 to 0.010 in. for broaching to size. The longer the bearing the greater the allowance.

2. Mandrels for split bearings (iron shells).

Mandrels for iron-shell split bearings up to 6 in. diam. should be made with an allowance of 0.06 in. for boring to size. When mandrel is over 6 in. diam. it should be made with an allowance of 0.06 to 0.12 in. The longer the bearing the greater the allowance.

3. Mandrels for split bearings (bronze shells).

Mandrels for tinned-bronze shells split bearings up to 7 in. diam. should be made with an allowance of 0.03 to 0.06 in. for boring to size. When mandrel is over 7 in. diam. it should be made with an allowance of 0.06 to 0.16 in. Here also the longer the bearing the greater the allowance.

Heating of Mandrels

Mandrels are heated to prevent the chilling of the babbitt when poured, and are coated with a thin wash of red clay mixed in water to prevent the babbitt from sticking to the mandrel and to prevent blow-holes in the babbitt lining.

1. Tinned-pipe shells and solid-bronze shells.

Preheat mandrel to 100° to 125°C. and maintain at this temperature, dip into a thin mixture of red-clay wash before babbitting each shell.

2. Tinned-bronze split shells.

Preheat mandrel to 125° to 150°C., and maintain at this temperature. Coat with a thin mixture of red-clay wash. This can be applied with brush or swab.

3. Split or solid cast-iron and malleable-iron shells.

Preheat mandrels to approximately 300° to 350°C. and coat with a thin mixture of red-clay wash. This can be applied with brush or swab.

Heating of Shells

1. Preheat cast-iron and malleable-iron shells to a tem-

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perature of 200° to 250°C. before babbitting so that the babbitt will flow close to the shell and also permit the shell and babbitt to shrink together and avoid loose babbitt.

2. All tinned shells (bronze castings and steel pipe) must be poured immediately after the tinning operation and no additional preheating is necessary.

Babbitting

1. Care of babbitt metal.

The babbitt must not be allowed to become hotter than 490°C. (914°F.) at any time and it must not have any metal or other alloy mixed with it. Use a pyrometer for determining the temperature and wherever possible use a regulator for controlling the temperature of the metal in the babbitting-pot. Melt the babbitt in an iron or steel pot, maintain the temperature of the metal when in use between 460°C. (860°F.) and 482°C. (900°F.) and at no time permit the metal to be heated above 490°C. (914°F.) Mix the metal thoroughly from the bottom of the pot as soon as melted, again at frequent intervals when being used, and always just before using after the metal has been standing in molten condition for any length of time.

If the pot is used only occasionally, cover the babbitt with sawdust or charcoal to prevent the formation of dross.

2. Pouring.

Ordinarily, pour all bearings in a vertical position unless the irregular shape of the bearing makes this position inadvisable, in which case incline the bearing at the most convenient angle and pour at the most convenient point.

In pouring a split bearing at an angle, the parting-face should be on the under side, resting on the jig.

Pour from a self-skimming ladle and pour in a steady stream directly along the mandrel in order to avoid the pocketing of air.

3. Repairing small defects:

Small blow-holes, if few, should be filled with the babbitt by the use of a hot soldering iron. If there are many blow-holes, or if seams have formed, the lining should be melted and the bearing re-babbitted.

Remove babbitt from lubricating-holes with a hot soldering-iron.

Peening or Rolling

Peen or roll split cast-iron and malleable-iron bearings above 5 in. diam., taking care to compress the babbitt equally over the whole surface. Care must be exercised in peening or rolling the metal not to distort it or produce in it any tendency to buckle. Do not peen or roll the tinned babbitted bearing.

Cleaning-Solutions

1. Hydrofluoric-acid solution.

Add 11 gallons of 16° Baume commercial hydrofluoric acid to 100 gallons of water. Specific gravity of solution 1.015 at 16°C. or 1.005 at 51°C. Maintain at temperature of 40° to 60°C. when in use. This solution must be replaced when its color becomes brownish.

2. Sulphuric-acid solution:

Add 10 gal. of 66° Baume commercial sulphuric acid to 100 gal. of water. Specific gravity of solution 1.072 at 30°C. and 1.08 at 68°C. Maintain at temperature of 60° to 80°C. when in use. This solution should be replaced when its color becomes brownish.

3. Caustic-soda solution:

Add 38 lb. of caustic soda to 100 gal. of water. Maintain at temperature of 80° to 100°C. when in use. Keep surface of liquid free from scum and replace when its color becomes brownish.

4. Red-clay wash:

A thin mixture of red clay in water. Just enough clay is used to give red color to the mixture. Stir before using. This solution should be replaced when it turns from a milky to a brown color.

Materials

1. Shells are made of cast-iron, malleable iron, bronze, or steel pipe as specified.

2. Babbitt metal.

The babbitt metal for which this process was originally prepared is the lead-base babbitt already described known to Westinghouse Electric & Manufacturing Co. as alloy No. 25, with a Brinell hardness of not less than 25 and not more than 31.

3. Alloy No. 19 is a solder used for tinning the surface of bronze and steel pipe bearing-shells (approximately 35% tin, 65% lead).

4. The tinning flux used is zinc chloride.

Admittedly this is an old story, but it has the distinction of possessing a new twist at the end.

A man died. He willed all his earthly possessions to be divided among an Englishman, an Irishman, and a Scotchman. But the will was conditional; each of the legatees was to place five pounds in the testator's coffin. On the day appointed the Englishman placed a five-pound note, as willed; the Irishman collected a number of coins somehow—shillings, sixpence, and coppers—and made up his contribution of five pounds, which he placed on the Englishman's fiver. The Scotchman then made out a check for fifteen pounds and, pocketing the ten pounds already deposited, threw his check with the remark, "That's easier."

A month later, when the Scotchman perused his passbook, he was surprised to find that his check had been cashed.

The undertaker was a Welshman.—'London Sketch'.

In a certain Yorkshire town a landlord does not receive a hearty welcome on Monday mornings and one of his tenants there recently handed the landlord half a crown toward the rent.

"Is that all you've got for me, and you so much in arrears?" scowled the landlord.

"Go on, now, and be satisfied," replied the tenant. "You wouldn't have had that only my old man has been and sold the back-door."—'Los Angeles Times.'

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City Gas as a Casehardening Agent

By H. M. CRAWFORD

CASEHARDENING by the use of city gas as a carburizing agent in place of solid carburizers is a comparatively new development, but enough has been done already to demonstrate its practicability and to show some of its advantages. Mr. Crawford is engineer for the Industrial Gas and Heating Department of the Pacific Gas & Electric Company.

In the ordinary casehardening methods the general procedure is approximately as follows: Metal boxes to be placed in the furnace must first be carefully packed by hand with alternate layers of carbon compound and steel parts. Each piece must be covered with the compound, for if two pieces of steel touch, a soft spot may be caused. There are many carburizing compounds on the market, the chief constituent being pure carbon, which in the presence of other ingredients evolves carbon monoxide gas. The compound must continually be renewed in the operations and is an important item in the cost per pound of steel carburized. Carburizing-boxes, which are continually subjected to temperatures well above 1700°F. and to combustion gases, are short-lived and costly. Some special (and expensive) heat-resisting alloy is often employed. Boxes should be as small as practicable, as a 12-in. box will frequently require four or five hours to heat throughout. This means that the steel parts in the furnace do not begin to be carburized until four or five hours after the furnace is started. Close regulation of temperature is also an essential part of the carburizing process.

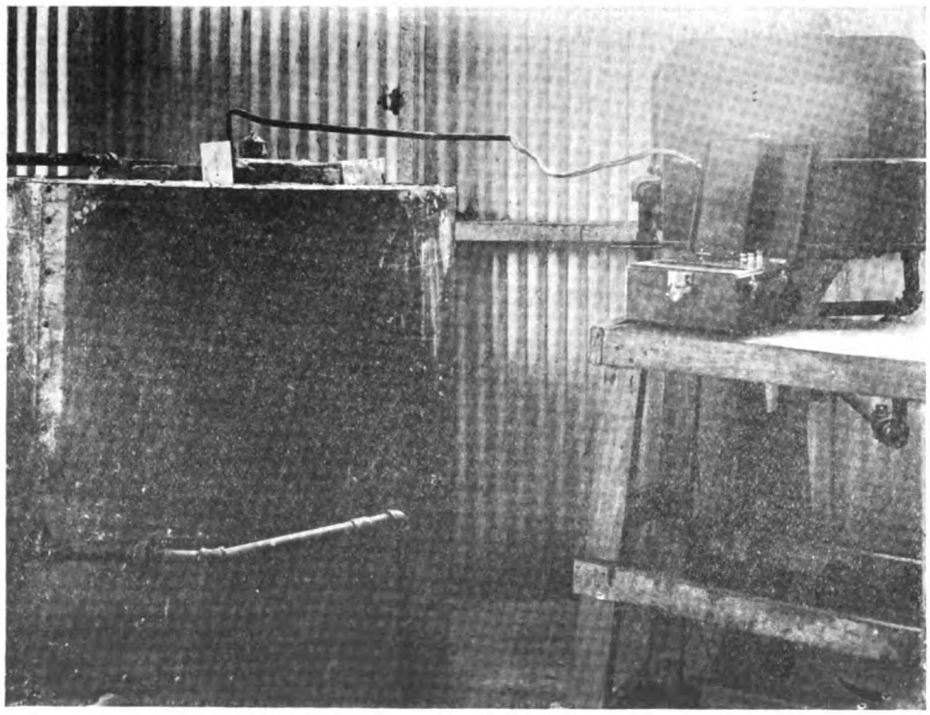
It has been demonstrated many times, however, that the average furnace filled with carburizing-boxes does not impart a uniform heat to the steel contained therein, as some of the boxes are more directly exposed to the fire than others, with the result that some of the steel parts are treated at too low a heat while others are overheated. The heat in the interior of the boxes cannot well be measured in practice and the color-test is usually required to supplement the pyrometer. It is difficult to produce the best results with such methods.

It will be of interest to note the effect of temperature upon the penetration of carbon as shown in the following table compiled by Robin.

Results of Carburizing Low-Carbon Steel for Seven Hours in Illuminating Gas at Various Temperatures

	Carbon % at depth of				
Temperature	1 mm.	2 mm.	3 mm.	4 mm.	5 mm.
1472°F.	0.21	0.105	0.048	....	....
1652°	0.363	0.21	0.057	0.03	....
1742°	0.451	0.219	0.093	0.049	....
1832°	0.579	0.321	0.241	0.152	0.091
1922°	0.594	0.365	0.322	0.212	0.15
2012°	1.522	1.487	1.284	1.147	0.988
2102°	1.637	1.604	1.382	1.330	1.195

We are indebted probably to Kurek or Robin for the first suggestion to employ city gas for a carburizing agent instead of solid compounds. Practical furnaces have now been built using city gas as the active carburizing agent. Some of the most extensive investigations of the subject have been made by the Industrial Heating Department of the Pacific Gas & Electric Co. at its experimental plant in San Francisco. One type of apparatus used consists of a steel cylinder 18 in. diam. by 24 in. long, which is entirely enclosed in a furnace provided with the necessary number of burners. The cylinder is provided with a gas-proof cover on top and with openings to admit and to exhaust air.



GAS-CARBURIZING FURNACE. LEADS ARE SHOWN CONNECTED TO PYROMETER

The sketch of the furnace shown on page 387 gives the general plan. Gas is used in two ways, (1) to produce the

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necessary temperature in the furnace with the usual burners and a positive-pressure blower, and (2) to pass gas through the cylinder filled with steel parts. This gas is simply allowed to come into contact with the steel. It reaches a temperature of 1700°F., but, as no air is admitted, it is not consumed, and is expelled from the cylinder by its own pressure, being burned at the point of exhaust as an illuminating flame. In this particular furnace, however, the exhaust-gas is piped into the furnace again and there supplied with air at one-pound pressure and used over again in separate burners to help maintain the heat of the cylinder. Both of these uses of gas are separate and distinct operations, independent of each other. Many modifications of this general plan are possible in commercial work according to the special requirements of the shop.

The steel to be treated is dumped promiscuously into the cylinder, no packing or separation of pieces being necessary. The furnace is brought to the required temperature in less than one hour. Gas is then admitted into the cylinder in contact with the steel. City gas under these conditions, breaks down, the hydro-carbons changing to free carbon and hydrogen and the carbon di-oxide and water vapor present reacting to form carbon monoxide and hydrogen. Carbon monoxide responds readily to increase in pressure while some other gaseous carburizers do not. Hood says, in discussing the chemical reactions involved, that if the pressure is increased the reaction will proceed in such a direction as will tend to relieve the pressure by a reduction in volume. The following equations illustrate this point,

$$2CO = CO_2 + C$$
2 volumes 1 volume

$$CH_4 = C + 2H_2$$
1 volume 2 volumes

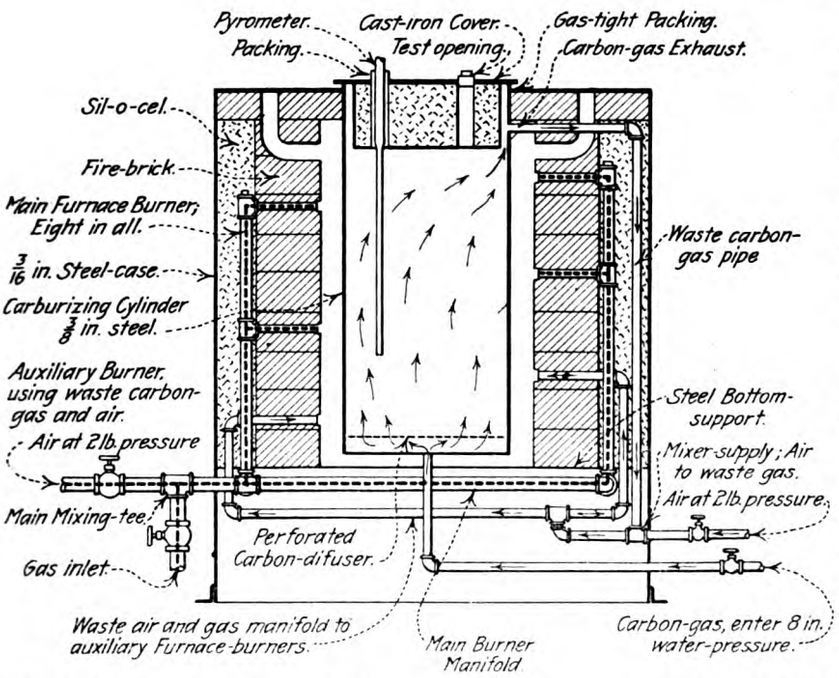
$$C_2H_6 = 2C + 3H_2$$
1 volume 3 volumes

proving that the decomposition of carbon monoxide into carbon di-oxide reduces the volume to one-half the original while the other reactions cause an increase in volume. Consequently carbon monoxide will carbonize faster when the pressure is increased. The gases, thus produced, act as strong carburizing agents.

In comparison with the present solid-compound methods, it is therefore seen that the use of city gas eliminates compounds, packing, metal boxes, and also the human element, which is so important in connection with their successful use. As has been shown, temperature is all important in casehardening.

In using the gas-furnace already described, it is necessary merely to employ a pyrometer, which can be inserted in the gas-cylinder, thus recording the actual temperature of the work at all times, something which is nearly impossible with other methods. Under actual operating conditions, a temperature varying only a few degrees from 1700°F. can be maintained for several hours in the gas-furnace providing an almost perfect carburizing condition.

Tests of many different kinds of iron and steel have shown an excellent 'case'. Common band-iron has been carbonized so thoroughly that subsequent heat treatment makes it brittle as glass. Steel pins kept at 1700°F. for two hours, using 80 ft. of city gas per hour in the cylinder, show $\frac{1}{32}$ in. depth of carbon penetration. One difficulty with the old methods of casehardening has been the tendency to crack the core or to separate it from the outer case produced. By using gas perfect diffusion can be obtained by soaking the material after the carburizing gas has been turned off. In other words, the steel is subjected to heat but not to further gas. This cannot be done with solid compounds. Almost any penetration can be obtained, depending upon the temperature employed and the amount of gas used in the cylinder. The best practical results seem to be obtained when just enough gas is admitted into the cylinder to produce a light deposit of free carbon on the metal being treated. No scale has been noticed on any work produced and fractures have shown uniformity in case and hardness.



DIAGRAMMATIC SKETCH OF GAS-CARBURIZING FURNACE, SHOWING GENERAL TYPE OF CONSTRUCTION AND THE BURNER-ARRANGEMENT. PIPING WITH DASH-LINES INDICATES ORDINARY BURNER CONSTRUCTION. THE OTHER PIPING IS FOR THE CARBURIZING GAS AND FOR THE FINAL APPLICATION OF WASTE GAS FROM THE TOP OF THE FURNACE TO THE AUXILIARY BURNERS. ARROWS SHOW THE DIRECTION OF GAS TRAVEL.

It is certain, from the results obtained, that city gas can be successfully employed for casehardening and will give a great saving of both time and labor. In fact, the human factor, so important in other processes, is practically eliminated. The use of gas will enable the practical op-

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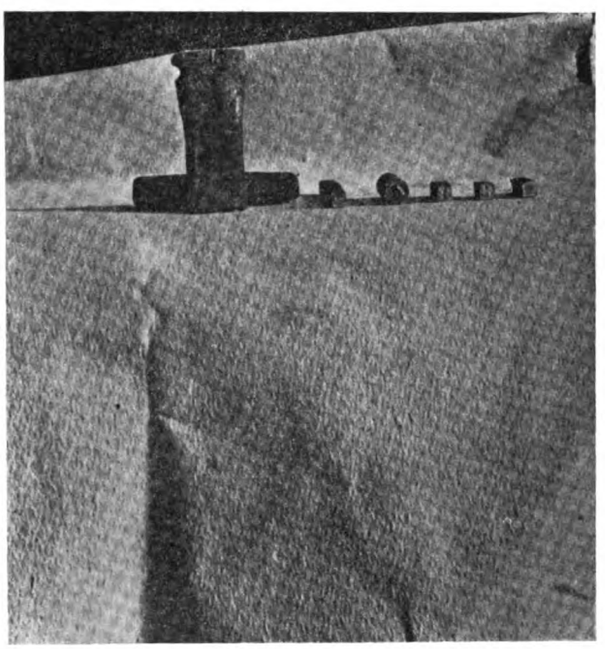
erator to maintain exactly the temperature required for the best results, and to apply carburizing gas in constant volume at any desired intervals. The result is certain to be a uniformity and quality in casehardening work that has hitherto been impossible. The possibility of having automobile and other parts of standard hardness and strength, is one that is certain to make a strong appeal to the manufacturer.

Since the introduction of gas carburizing, a number of manufacturers have adopted the use of city gas. The process is already in successful use in several Pacific Coast plants and is being seriously considered in many



SPECIMENS OF WORK CARBURIZED WITH GAS

others. There is much to learn about any process of this kind, in fact, any process for the treatment of steel involves many problems, but it is to be hoped that the introduction of gas will add, in a small measure, to the already great science of metal treatment.

In brief, therefore, the user of city gas for casehardening can obtain complete control of temperature as well as a uniform temperature throughout his furnace. A uniform 'case' is obtained blending gradually with the core with no sharp line of demarcation between them. Furthermore, the time reequired both for heating the furnace and for the actual carburizing is much less than when other methods are employed, and the labor in packing carburizing-boxes is eliminated.

JUDGE: Where did the auto hit you?

Rastus: Well, Jedge, if I'd been carrying a license number it would hab busted to a thousand pieces.—'The Yellow Strand.'

RED CROSS CANTEENER: "And while you were in Ireland did you kiss the Blarney Stone?"

The Returned Hero: "No, but I kissed several who had."

A Core Used to Advantage

By WALTON F. AVERY

Under the heading, 'Aluminum-plate patterns', in the August number an illustration was given of the advantage of avoiding cores when possible in order to get quantity production. Results justified the use of a plate in that case, since the number of molds was increased from 10 to 40 a day and better castings were produced. On the other hand, it sometimes happens that while the

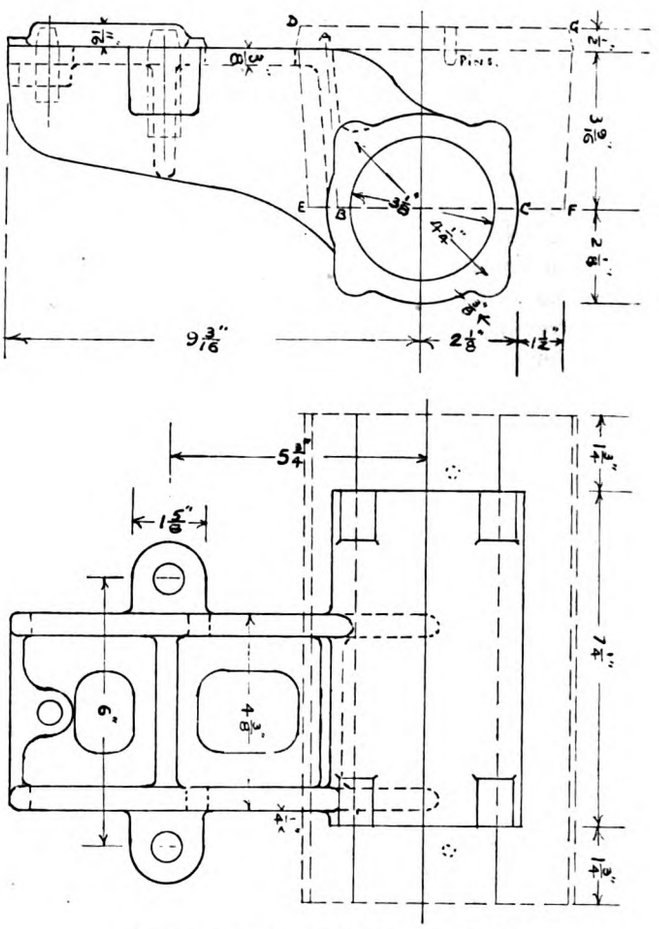


FIG. 1 AND 2. BRACKET PATTERN

use of a core may be avoided especially for the outside of a casting, yet in actual practice its employment would give better results.

Fig. 1 and 2 show a bracket that was made from a pattern on a follow-board and parted along the line *ABC*. The foundry foreman changed the method of molding by having a print put on the pattern as shown along the dotted lines *DEFG*, and having the core made to fit snugly in the mold. Cores made by using compound in the proportion of 90 to 1 with equal parts of new and old sand can be removed practically whole after the metal has been poured so the molding-sand is kept free of core-sand. Using a hardwood pattern the molder on the ordinary board in a 12 by 14-in. snap-flask increased his output from 12 to 36 castings a day.

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Machining Operations in Manufacturing a Cylinder Re-Boring Device

Rigging for quantity production according to the most economical methods, which used to be considered practically out of the question for Western manufacturers, has now become common, not only by the large concern but also by some of the smaller companies, whose output is confined to one or two articles, for which, however, there is a considerable possible demand.

The accompanying illustrations show some of the machining operations, together with some of the fixtures used, in the manufacture of a cylinder re-boring machine, by the Hughson-Bacon Co. of Oakland. This device was more fully described in 'Metal Trades' for April. Briefly it is a light portable and relatively inexpensive and 'fool-proof' apparatus for re-boring scored or otherwise worn cylinders, particularly cylinders for

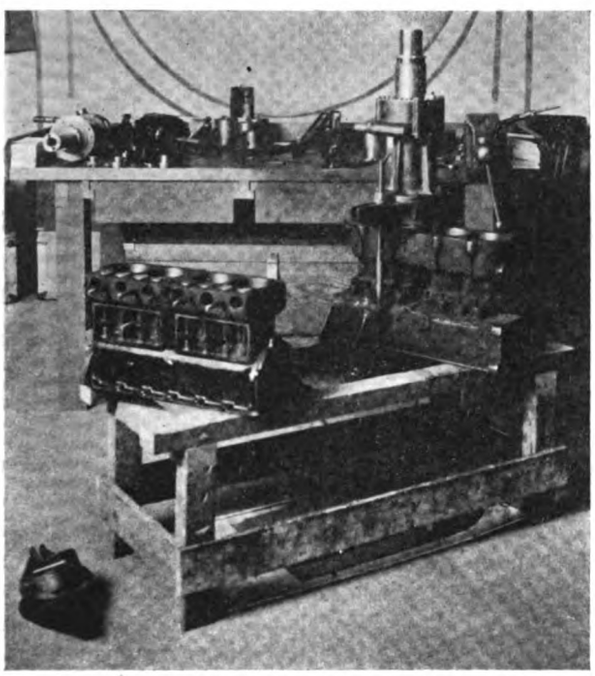

FIG. 1. MACHINE IN POSITION FOR BORING CYLINDERS

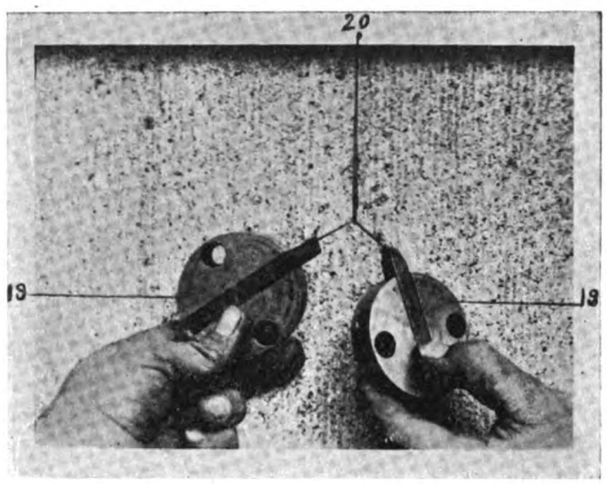

FIG. 3. CUTTER-HEADS AND TOOLS FOR ROUGHING AND FINISHING CUTS

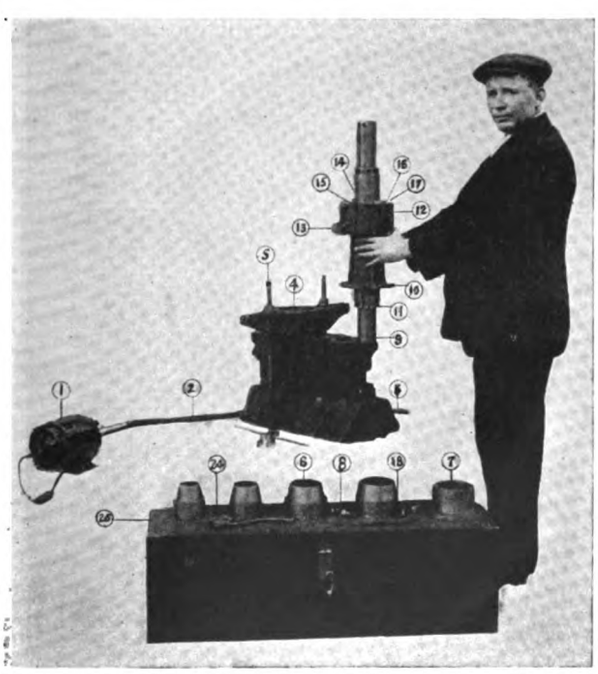

FIG. 2. MACHINE PARTLY DISASSEMBLED

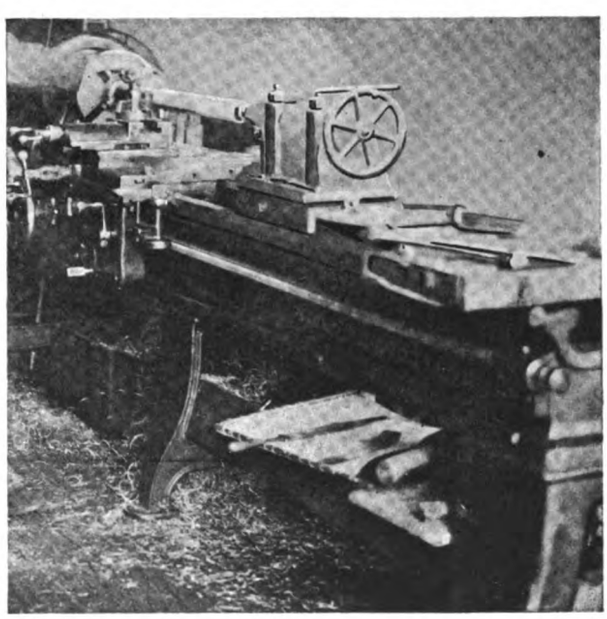

FIG. 7. TURNING BORING-BAR

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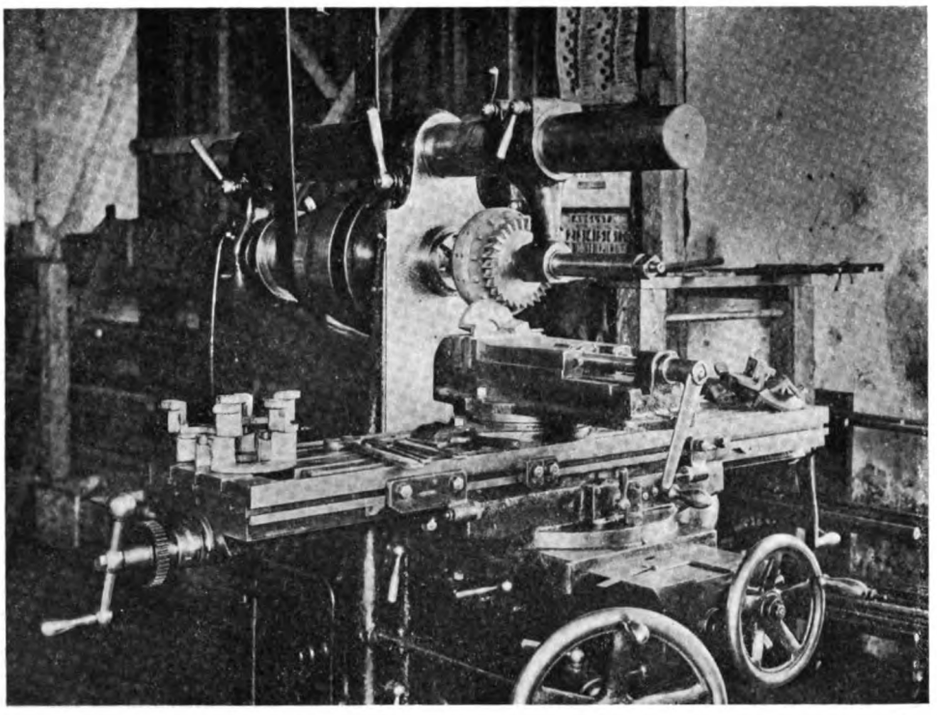

FIG. 8. MILLING FEED-GEAR BRACKET

automotive engines. The special advantage as compared with other equipment for this work is that the cylinders for most engines can be re-bored without removing the block from the car, thus effecting a great saving in time and expense. Fig. 1 shows the machine in position for re-boring a cylinder, while Fig. 2 shows it partly disassembled, (1) being the $\frac{1}{6}$-hp. induction-motor to drive the machine, (2) the flexible drive-shaft, (3) the worm-drive, (4) the machine-base, (5) one of the base-clamps that hold the engine in place, (6) four tapered cones to handle cylinders from $2\frac{1}{2}$ to $5\frac{1}{16}$ in. diam., (9) the boring-bar; (10) the bottom housing, (11) bronze take-up bushings, (12) the middle housing, (14) the upper housing, and (13) the worm-housing. Fig. 3 shows the cutting-heads and tools for roughing and finishing cuts.

In order to make economical production possible, a complete set of jigs and fixtures was designed, some of which are shown in the photographs. The lower part of Fig. 4 shows the operation of turning one of the cones on a Rockford lathe, while the upper corner gives a 'close-

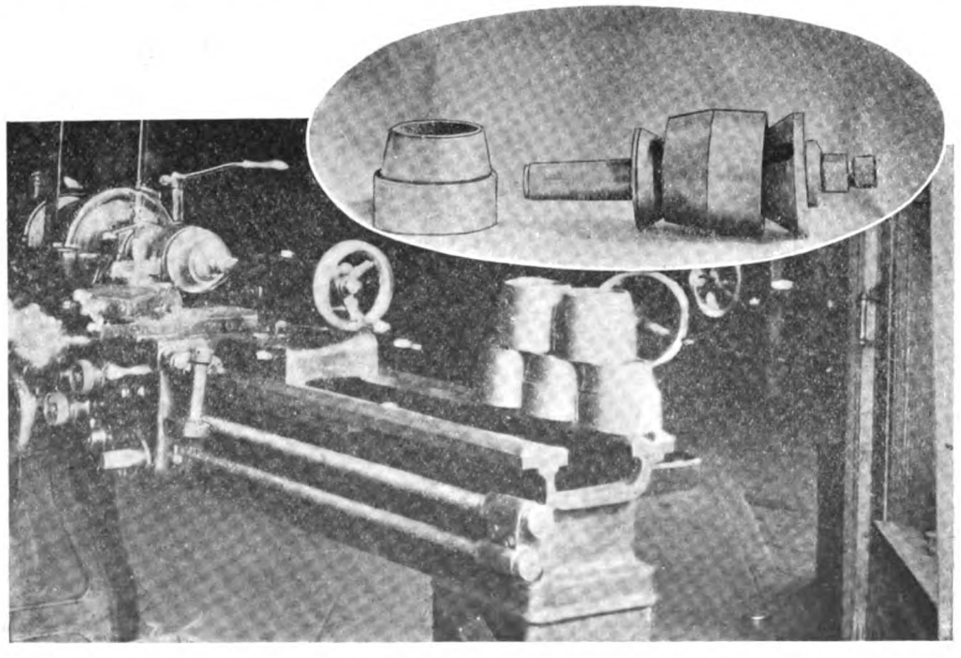

FIG. 4. TURNING CENTRING-CONES. ABOVE, CONE HELD IN FIXTURE

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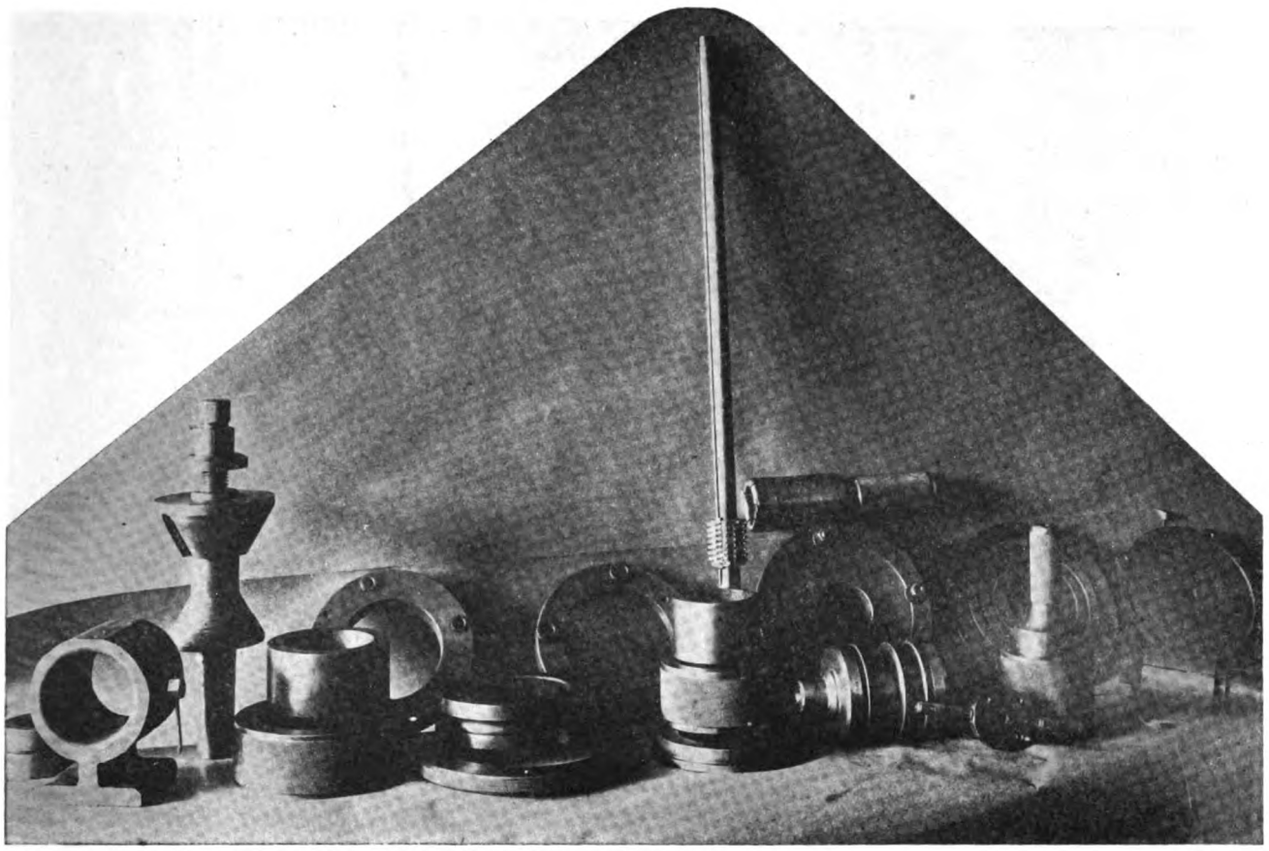

FIG. 6. GROUP OF GAUGES, JIGS, AND FIXTURES

up' view of the fixture and the method of holding the cone in it. Fig. 5 shows a group of jigs and fixtures. Reading from left to right, these are as follows:

A small drill-jig, a drill-jig for the feed-gear bracket, a holding-fixture for boring the centre housing on a lathe, a plug-and-ring gauge for the tool-head, another drill-jig, and a drill-jig for the boring-bar. On top of this drill-jig there is another one for the tool-heads. Continuing from left to right, there is a gauge for the bronze bushing, a drill-jig for the top-housing, a drill-jig for the automatic stops in the boring-bar, a holding-fixture for use on the lathe in making the star feed-gear, and a holding-fixture for the cones. On top of the latter is a plug-and-ring gauge for the boring-bar, and in front of this is a holding-fixture for milling the tool-heads. Lastly, we have a holding-fixture for cutting the worm on the milling machine.

Similarly, we have in Fig. 6, also reading from left to right, the following:

A drill-jig for the top and bottom housings, a holding-fixture for the cones, a plug-and-ring gauge for the wing-base, a drill-jig for the bottom housing, a plug and a

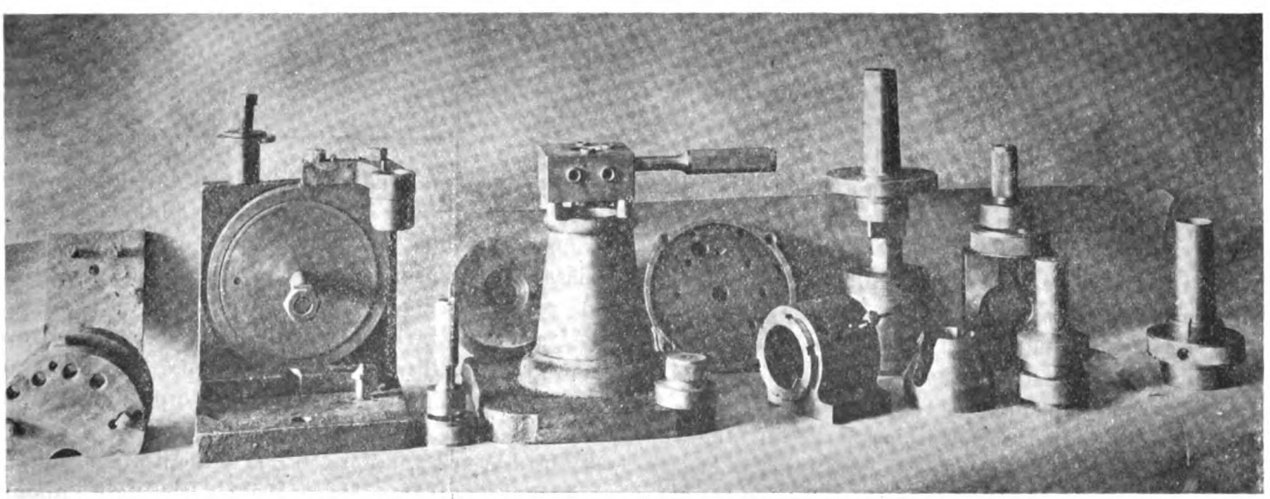

FIG. 5. GROUP OF GAUGES, JIGS, AND FIXTURES

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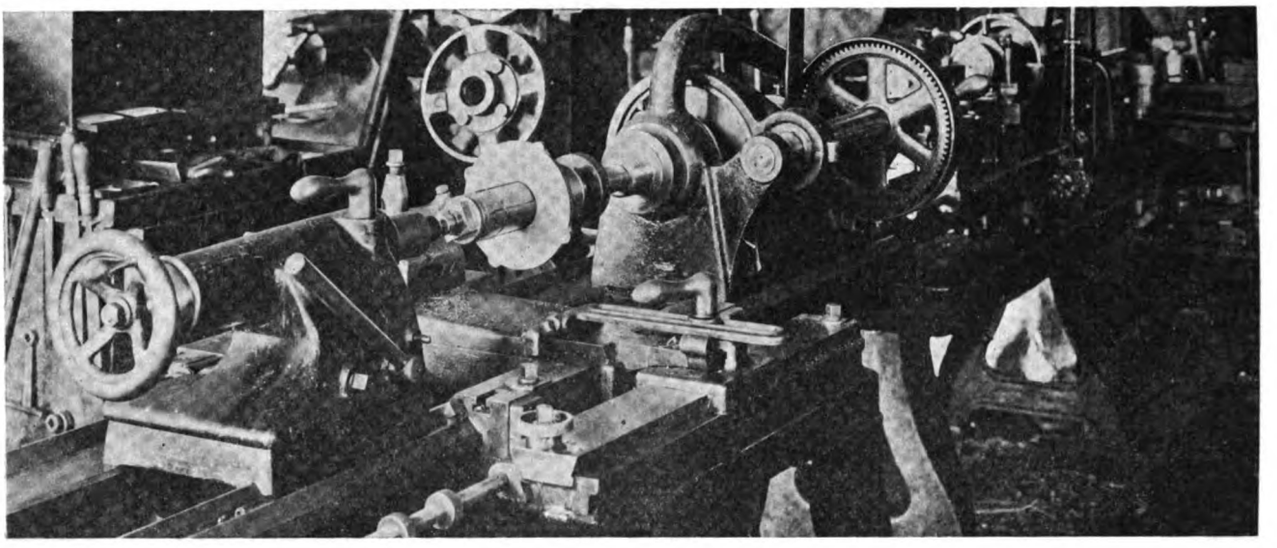

FIG. 9. TURNING AND FACING HOUSINGS

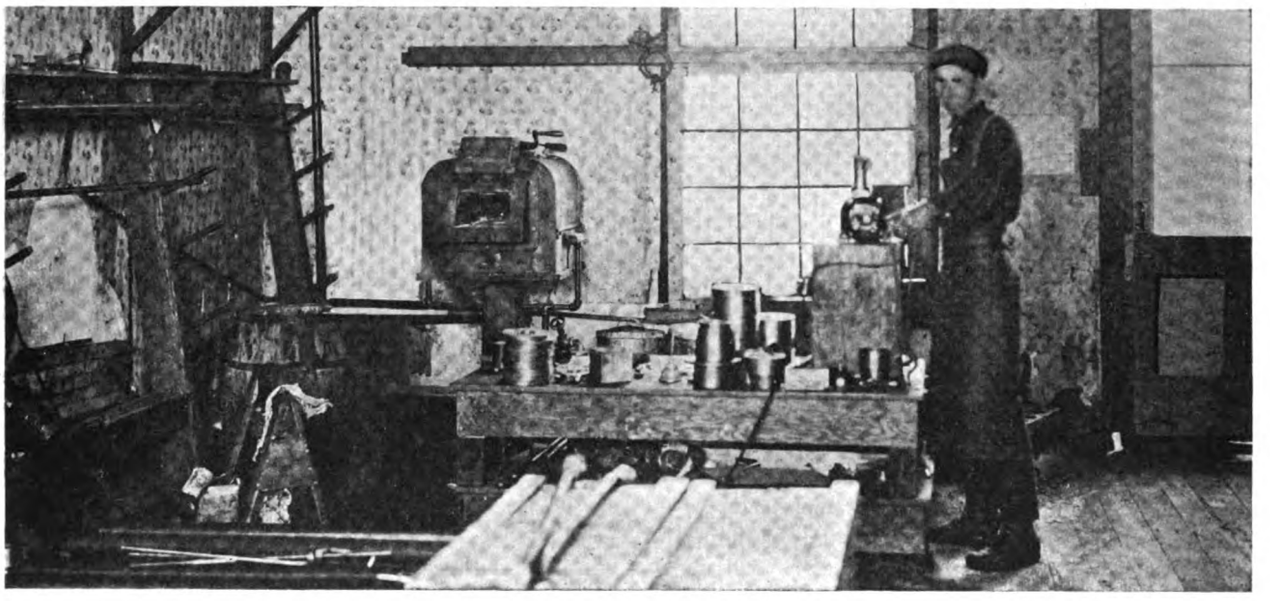

FIG. 10. HEAT-TREATING DEPARTMNET

ring gauge (one above the other), for the top housing, a drill-jig for the wing-base, a plug-and-ring gauge for the cones. On top of this is the hob for cutting the rack in the boring-bars. Next comes a holding-fixture for turning the top and bottom housings, and on top of this holding-fixture is another one for milling the bronze bushings. Next comes a holding-fixture for hobbing the worm-gears. Then we have a taper plug-and-ring gauge for the bronze bushings, while back of this gauge is a drill-jig for the boring-bar. Next is a holding fixture for milling the bronze bushings and behind it is a drill-jig for the bottom housing.

Fig. 7 shows a Lodge & Shipley lathe turning the boring-bar, which is made of special tubing. Fig. 8 shows the operation of milling both sides of the feed-gear bracket in a No. 3 Hendey universal milling machine. Fig. 9 shows the set-up for turning and facing the top and bottom housing in a Hendey lathe.

IT would seem that prohibition is hitting everything that can be hit, and is altering most of them. Even the drama seems due for a revolution, according to David Belasco, who recounts this conversation with an up-to-date playright:

"I thought you told me this play was written to suit prohibition conditions," said Belasco. "I have read it and I do not find a single reference to prohibition conditions."

"But haven't you noticed that it is all in one act?" explained the author. "It runs right through without an intermission."—'Los Angeles Times.'

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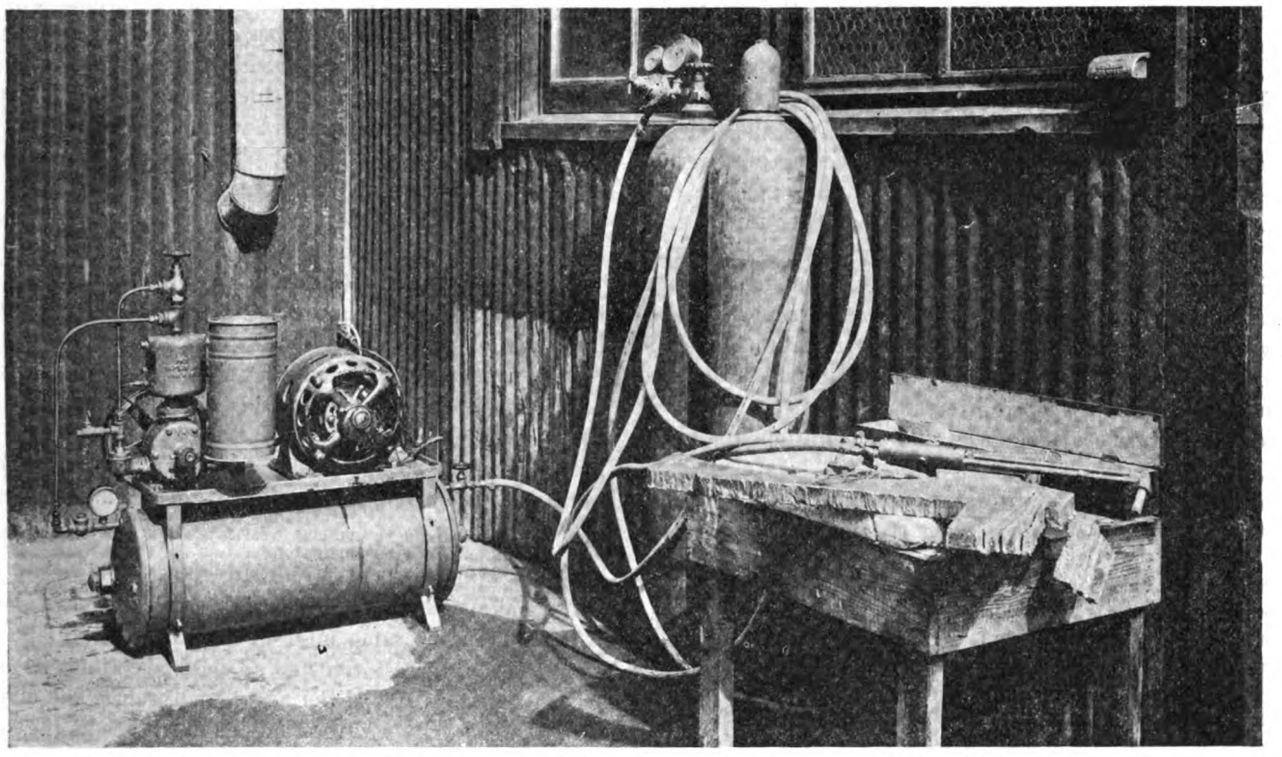

EQUIPMENT FOR CUTTING WITH CITY GAS DESIGNED BY INDUSTRIAL DEPARTMENT OF PACIFIC GAS & ELECTRIC COMPANY

City Gas v. Acetylene or Hydrocarbon for Cutting Steel

By LETSON BALLIET*

In cutting steel with oxygen there is often a wide difference in the condition of the finished cut. This makes a big difference in the cost of work. Before considering the reasons for this, let me make the following general statements.

1. A cold piece of steel wire may be inserted into a bottle filled with oxygen, and no visible action will take place; but if you hold that wire in a stove, over a gas-jet, an alcohol-lamp, or a candle, until some spot is red-hot, and then insert it in the bottle of oxygen, the wire will burn. As with any other fire, some point must be above the ignition temperature to start it, after that it makes its own heat and burns the entire wire.

2. After the steel wire has been heated red-hot at some point to start the burning, nothing but oxygen is needed to keep it going.

3. The same principles govern cutting steel with an oxygen blow-pipe or torch. The plate is too heavy and cumbersome to put into a bottle of oxygen so the oxygen is brought to the plate through the blow-pipe and directed against the spot to be burned.

4. Two gases are generally used, one, called the preheating gas, to bring some spot up to a red heat, after which the oxygen-jet is turned on the red spot, and the burning begins.

5. It makes no difference whether you heat the first spot to a red heat in a bonfire, with an alcohol-lamp, with a candle, with matches, with acetylene, or with hydrogen, just so there is some spot hot enough to start the burning when the oxygen is applied.

6. A piece of steel can be heated in a blacksmith-forge until it is red-hot and, if a jet of oxygen is turned upon the red-hot spot, it can be cut or burned in two without any other gas than the oxygen.

7. A temperature of 1200° to 1300°F. is sufficient to produce a good cherry-red and to start the burning. To heat the piece to a higher temperature is a waste of fuel. It is the same as using two or three matches to light a cigar, one is enough.

8. A piece of steel or shafting can be laid across an ordinary blacksmith-forge until it is red-hot, and, by using a jet of compressed air, it can be burned in two. The operation is, however, not efficient. The cut is wider than with oxygen, and is ragged and rough because of the large proportion of nitrogen in the compressed air. The nitrogen absorbs heat and expands rapidly; hence the increase of the width of the cut and its ragged edges.

9. The manner of the preheating has nothing to do

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with either the width or the smoothness of the cut, which are governed entirely by the purity of oxygen used.

As little as ¼% of inert impurities in the oxygen will affect (1) the quantity of oxygen required, ()2 the width of the cut, (3) the roughness of the cut, (4) the time required for cutting, and this is irrespective of the particular fuel used for preheating, whether alcohol, city gas, acetylene, hydrogen, coke, coal, or fuel-oil.

Cutting steel with oxygen and city gas has been tried with various degrees of success in a number of places throughout the United States. The usual report regarding such experiments has been that 'it takes too much oxygen and is too expensive'. This has been fostered and encouraged by those interested in the production of hydrogen and acetylene gases and the equipment for use with those gases.

It is often necessary to start an experiment with the whole force of operators, from the management to the lowest-paid man in the plant in a skeptical frame of mind. Under such conditions many seemingly lie awake all night trying to find reasons why an experiment will not work instead of trying to find some improvement to make it work successfully.

The development of city gas for cutting metals has been hindered by skepticism on the part of the users.

Published reports of experiments made by or for those who were interested in the manufacture or selling of acetylene and acetylene equipment tend to support the contention that acetylene produces the best and most efficient results. Similarly the published reports of experiments made by or for those interested in hydrogen and hydrogen equipment show hydrogen as the most efficient. On the other hand, the manufacturers of city gas assumed that the possible market for this purpose would be so small that they made no effort to enter the field. A few independent experimenters admitted that 'city gas will cut about as fast', but they had little accurate data upon quantities of gases or condition of the cut. Practically all agreed upon two things, 'Cutting can be done with city gas' and 'The edge of the finished cut is softer than when cut with acetylene, and reamers and machine-tools would not be seriously damaged when used in facing the edges of the cut.'

Almost every experimenter in trying to be fair, reported that all cuts by each gas were made by the same operator, with the gases at the same pressure through the same torch on the same thickness of plate on the same day, etc. A statement of this kind in itself proves the unreliability of such tests, for the gases do not combine with oxygen alike. For example a hydrogen-torch that delivered the right amount of hydrogen for a given amount of oxygen, would not give the best efficiency with either city gas or acetylene, hence the results of such a test were in favor of hydrogen. Similarly experiments conducted with acetylene-torches indicated that acetylene was the most efficient. Since no torches designed for city gas are upon the market, such gas was always used at a handicap in one of the other torches. Such unequal conditions too often exist when experimental work is undertaken.

The use of torches and other equipment designed for either acetylene or hyrogen in burning city gas does not give the latter a fair show. For the best results, equipment designed for use with city gas should be employed.

The first thing to do, in my experiments, was to design torches and tips adapted to city gas. When this was done and city gas was dressed in clothes that were tailored to fit, improved performance in the tests was noted.

Analysis showed that hydrogen gas contains 345, acetylene 1600, and city gas 570 b.t.u. per cubic foot. Since hydrogen as well as acetylene is commonly used for cutting, it is logical to assume that if hydrogen with its 345 b.t.u. per cubic foot can give heat enough to preheat steel for cutting, city gas with 570 b.t.u. could also do so. For that reason the standard of gas measurement for the experiments was changed to b.t.u. instead of cubic feet.

570 b.t.u. could be obtained from 1 cu. ft. of city gas
570 b.t.u. could be obtained from 1.65 cu. ft. of hydrogen
570 b.t.u. could be obtained from 0.36 cu. ft. of acetylene

To make a fair test each torch was required to deliver 570 b.t.u. in the same interval of time. It will be seen that the hydrogen-torch had to pass five times as much gas in a given time as the acetylene-torch. The city-gas torch had to deliver three times as much gas as the acetylene and three-fifths as much as the hydrogen-torch.

Another factor to be considered in the experiments was the fact that each gas requires a different proportion of oxygen for complete combustion.

570 b.t.u. of city gas requires 1.1 cu. ft. of oxygen
570 b.t.u. of hydrogen requires 0.83 cu. ft. of oxygen
570 b.t.u. of acetylene requires 0.9 cu. ft. of oxygen

Thus it appears, that if 570 b.t.u. of each gas were burned with its own correct amount of oxygen in the same interval of time at the same speed of combustion that the same amount of heat must be given off, and that we can expect the speed of cutting to be the same with each preheating-gas, provided the quality of the oxygen is the same.

Neither city gas, hydrogen, nor acetylene does the cutting. They merely furnish the flame heat to preheat the metal. Oxygen has no b.t.u. value alone. Any one of these three gases burned with its correct amount of oxygen will furnish the required heat. Speed in preheating depends entirely upon designing the torch to get the quickest combustion. The actual cutting depends on the oxygen, not on the preheating-gas.

Speed in preheating depends entirely upon designing the torch to get the quickest combustion. The actual cutting depends on the oxygen, not on the preheating-gas.

The condition of the finished cuts showed that hydrogen and city gas produce almost the same results as far as hardness of the cut edge is concerned. Consequently the wear on tools used in machining the edges of the cuts is not so great as when the cuts are made with acetylene. The smoothness of the cut does not depend at all upon which of the preheating gases is used to bring the metal to the cherry-red

The smoothness of the cut is governed entirely by the purity of the oxygen and by its freedom from inert gases.

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color, but is governed entirely by the purity of the oxygen and by its freedom from inert gases. Likewise the speed of the actual cutting depends upon the purity of the oxygen and in no wise upon the preheating gas. The width of the kerf and the volume of oxygen used, also depend upon the purity of the oxygen.

The comparative cost of the gases per 570 b.t.u., is as follows, assuming oxygen to cost 1¼ cents per cubic foot, hydrogen, 1 cent, acetylene, 3 cents, and city gas, 72 cents per 1000 cu. ft.:

Oxy-hydrogen costs:	
Hydrogen	$0.0165
Oxygen	0.0104
Total cost of both gases, per 570 b.t.u.	$0.0269
Oxy-acetylene costs:	
Acetylene	$0.0108
Oxygen	0.01125
Total cost of both gases, per 570 b.t.u.	$0.02205
Oxy-city gas costs:	
City gas	$0.00072
Oxygen	0.01375
Total cost of both gases, per 570 b.t.u.	$0.01447

Thus it will be seen that the cost per b.t.u. for hydrogen cutting is 85% greater than for city-gas cutting, and that acetylene cutting is over 50% more expensive than city-gas cutting. City gas being piped at the low pressure of about 25 lb. shows an additional saving over the other gases, which are transported in containers, as cost of transportation, waiting for containers, time losses in changing hose-connections, cost of high-pressure regulators and losses from leakage are important factors in the cost of the finished product.

City gas is cheaper per b.t.u. delivered than either acetylene or hydrogen, and there is also a saving in many of the incidental items of cost.

The amount of oxygen required with city gas is more than with either of the other gases, but the low price of the city gas more than makes up the difference. If more gas is used than is indicated by these figures, it is either because of mechanical imperfection of the torch-design or because of incompetency of the operator.

With city gas the largest cut that has been required in my own experience was cutting through a stern-frame 10½ in. square, but this work gave no indication that the limit of cut had been even approached.

In attempting to use city gas for cutting we occasionally hear some one say, 'It isn't as good as acetylene or hydrogen.' Investigation usually shows that inasmuch as the operator is using a new gas, he is not getting his mixtures right, for each gas requires a different mixture with the oxygen. It may be that the operator is using an acetylene torch or some other makeshift for burning city gas. However, there can be no difference, provided the operator gets his mixture right, and a little experience will soon teach him how to do this.

Remember this, that neither the acetylene, hydrogen, nor the city gas does the cutting. It is the oxygen burning the steel, as it would any other fuel, that does the cutting, and the purer the oxygen the more rapid is the oxidizing or burning, after the other gas has kindled the fire.

It is the oxygen not the preheating gas that actually does the cutting.

Sometimes one cut may start more slowly than another. This may be on account of cold-air currents, unsteady hand of the operator, improperly adjusted preheating flame, or impure oxygen. After the point of kindling has been reached, with proper adjustments, proper gas-pressure, and an experienced operator, there can be no difference in the actual cutting as long as the purity of the oxygen remains the same. A difference of ¼% in oxygen purity will make a difference of 15% in the cost of the completed work, provided the impurity is an inert gas like nitrogen. In fact, demonstrators of torches and blow-pipes often lose sales simply because of the presence of 1% or 2% of inert impurities in the oxygen, which increase the time of cutting, the quantity of oxygen used, and the roughness of the finished cut.

A difference of ¼% in oxygen purity will make a difference of 15% in the cost of the completed work, provided the impurity is an inert gas like nitrogen.

CUTTING WITH CITY GAS AND OXYGEN

When, however, the impurity present is hydrogen, the temperature of the flame being above the temperature of disassociation of hydrogen and oxygen, the hydrogen passes out into the envelope-flame to be burned. Insofar as its b.t.u. value is concerned, this hydrogen might just as well have been contained in the acetylene or other preheating gas, and the value of the oxygen is not depreciated by the fact that the hydrogen was contained in it, except to the extent of the space it occupies. The amount of hydrogen found in oxygen is generally not over 0.6%, and I have never found over 1.2% in any commercial oxygen on the present-day market.

When nitrogen is contained in the oxygen, it too occupies space, but it will not burn, it expands rapidly, ab-

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sorbs heat, reduces speed of the work, fouls the cut, leaves ragged edges, and has a slight tendency to produce brittleness.

The technique of the casehardening of steel furnishes some interesting sidelights on the effect of the various gases used in cutting on the hardness of the edges of the cut. The object of casehardening is to produce a hard wearing-surface on low-carbon steel and at the same time to retain or increase the toughness of the main mass. The process is the impregnation of a thin film on the outer surface with more carbon than the mass originally contained, while maintaining a proper heat condition to temper the case and to obtain the desired condition of the 'core'.

Manifestly carburization requires the presence of free carbon in some form or other, either as a solid body or as a gas that will produce free carbon in its decomposition or combustion.

Heat facilitates the absorption of gases by steel. This is true whether the steel be heated in the atmosphere where the gases are nitrogen and oxygen, or in some specially prepared gas, such as carbon monoxide, city gas, or acetylene. When steel is heated to high temperatures in an atmosphere of carbon monoxide (CO), the gases will permeate the outer surface of the metal, while, at the same time the carbon monoxide decomposes when it comes in contact with the steel, and sets free a part of the carbon it contains. This produces casehardening.

Acetylene, C_2H_2, when burned in a neutral flame gives off as products of combustion, carbon monoxide and hydrogen. Thus when acetylene is used for cutting steel with the oxygen blow-pipe or torch, the burned edge of the cut is somewhat casehardened by carbon set free from the carbon monoxide.

The frequent complaints about the destruction of reamers and machine-tools when used upon edges that have been cut with oxy-acetylene burners arise from the fact that the edges so cut have been casehardened.

This indicates the advantage of the use of either hydrogen or illuminating gases for steel cutting, because the products of combustion are either water or carbon dioxide (CO_2) and water, neither of which will set free any carbon to caseharden the edge of the cut.

The action of nitrogen upon steel has only recently been appreciated. Casehardening and tempering has been attempted in an atmosphere of nitrogen, but it was a failure because no carbon could be set free to increase the carbon content of the steel. At the same time increased brittleness was noted in the product.

When a piece of steel is heated in ordinary air nitrogen will diffuse in small amounts into the steel during carburization, but this neither increases nor aids carburization. In fact, instead of nitrogen being a requisite, as many yet believe, it may even exert a pernicious effect. Le Chatelier found that the increase in brittleness sometimes observed in casehardening is caused by the presence of nitrogen. Bullens, after quoting Le Chatelier, adds, "It might be added that the deleterious nitrogenizing effect is further supported by experiments along other lines."

Experiments in the strength of autogenous welds prove clearly that the purity of the oxygen used has much to do with the strength of the weld. Oxygen which is free from nitrogen produces the highest strength in the welds as well as the greatest efficiency in gas consumption and time. Oxygen that is obtained by electrolysis from distilled water (H_2O) has less than 1% of impurities in the form of hydrogen. When used in welding with aceylene, this amount of hydrogen is burned in the envelope flame without seriously detrimental effect.

The statements of authorities as well as the results of experiments indicate that for preheating when cutting steel, illuminating gas and hydrogen will leave a much softer edge than acetylene, which is easier on machine tools and reamers.

For welding steel commercially, acetylene must be used, and it is quite evident that nitrogen-free oxygen will give the better results for strength, speed, and toughness of the weld.

It is now interesting to note why, except in the case of laboratory experiments where an excess of hydrogen is used, neither city gas nor hydrogen can be used for welding, although they are so efficient in preheating for cutting. As explained above, acetylene when burned in a 'neutral' or a reducing' flame yields carbon monoxide and hydrogen as the products of combustion. Both of these gases have a high affinity for oxygen when hot, and they literally surround the work at the point where the metal is molten with an atmosphere that excludes the oxygen of the air from coming in contact with the molten metal. It is probable that the welded section of the steel may be slightly casehardened by the action of the monoxide, but the metal is neither oxidized nor burned.

On the other hand, when either city gas or hydrogen are used, the products of combustion are carbon di-oxide and water. Hot steel will be attacked by oxygen from the water (H_2O), from the carbon di-oxide (CO_2), and from the air, which cause the weld to be burned or oxidized instead of being fused in a reducing flame. (Laboratory experiments excepted as above.)

"It is a strange," said the professor. "I was shaved this morning by a man who really is, I suppose, a little above being a barber. I know of my own knowledge that he studied at Heidelberg and spent several years in other foreign educational centres.

"I know, also, that he has contributed scientific articles to our best magazines and has numbered among his intimate friends men of the highest social standing. And yet," soliloquized the professor, "he can't shave a man decently!"

"By Jove," exclaimed young Rounder in astonishment. "What is he a barber for, with all those accomplishments?"

"Oh, he isn't a barber," said the professor, yawning. "You see, I shaved myself this morning."—'Los Angeles Times.'

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INDUSTRIAL EQUIPMENT

SELF-INDDUCTION REGULATOR FOR ELECTRIC-FURNACE VOLTAGE-CONTROL

For controlling the energy input for carborundum, graphite, aluminum, zinc, and similar types of electric furnaces, the Westinghouse Electric & Manufacturing Co. is manufacturing a step-induction regulator which gives a uniform voltage over a wide range. The regulator consists of a fur-

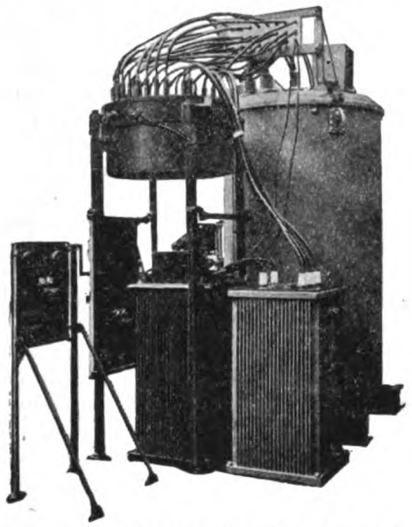

Fig. 1. Step-Induction Regulator Complete

nace-transformer, an induction-regulator, switches, and push-button control. By the use of this apparatus, the energy input to the furnace is controlled by varying the high-voltage tap on the transformer. The induction-regulator varies the voltage between taps. After the voltage of the adjacent tap is reached, the selector and transfer switches automatically transfer the induction-regulator so that it will function between the next two taps. The entire

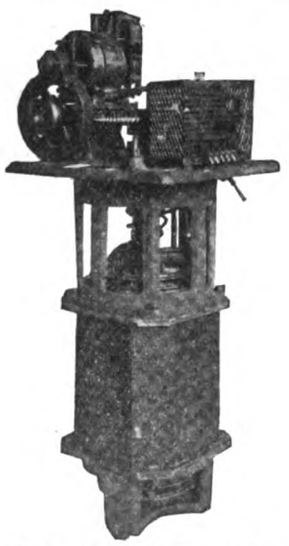

Fig. 2. Details of Construction

voltage range is controlled by two push-buttons, one for increasing and one for reducing the voltage.

The apparatus is constructed as follows: On the shaft of the regulator is geared a selector switch, the joints on this switch being connected directly to taps on the high-voltage winding of the furnace-transformer. The selector switch-arm moves from one contact to the next automatically as the induction-regulator moves. The function of the feeder voltage-regulator is to add to or subtract from the normal voltage of a transformer-tap and is designed so that at the position of maximum rate of increase it will add exactly one-half of the voltage between adjacent transformer-taps, while at the position of maximum reduction it will subtract one-half the voltage between adjacent transformer-taps. Considering, then, a single position of the selector switch-arm, a single rotation of the moving coil of the induction-regulator will vary the voltage impressed on the high-tension winding from a position one-half step below to a position one-half step above the voltage-point actually repre-

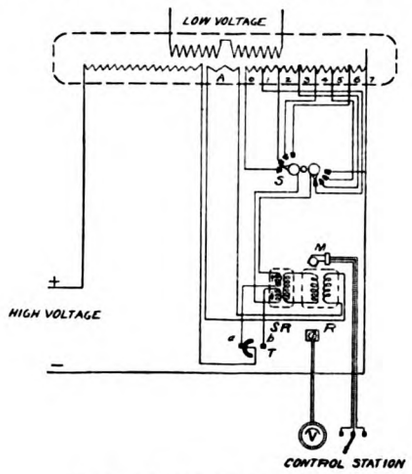

Fig. 3. Diagram of Connections

sented by the transformer-tap. The selector-switch arm is moved from one tap to the next just as the voltage one-half way between adjacent taps is reached, so that continued rotation of the regulator-coil produces a continuous variation, raising or lowering the voltage according to the direction in which the regulator-coil is being turned.

Any voltage within the range of the extreme taps on the transformer winding may be obtained by closing a two-way switch in either a 'raise' or 'lower' position, the voltage-setting of the regulator being indicated by an adjacent voltmeter.

MAINTENANCE OF THE LIGHTING SYSTEM*

The proper maintenance of the lighting equipment is an important factor in illumination. The housewife realizes that the home would soon become a poor place in which to dwell unless she made periodic house-cleanings. The industrial plant, or office, would soon become unsanitary unless the scrub-people were employed. On the other hand, lighting equipment is often neglected from the time it is installed until it becomes obsolete. People seem to believe that after once hanging a fixture and screwing a lamp into a socket no further attention needs to be given to this part of the home or office. An official of the Department of Labor, addressing a convention of electrical contractors and dealers, said:

"If you sell a man a motor, you usually give him an instruction-card telling him how to oil the motor, adjust the brushes, and the like. If you did not do this and he did not attend to the matter through his own appreciation of the subject, the motor would soon stall, burn out, and you would be justly blamed. On the other hand, many a lighting system is sold with no instructions or suggestions as to its maintenance. A lighting system demands careful maintenance. If it does not receive it, the intensity will soon drop so low that the men cannot see to perform their work."

As the Mazda lamp is burned, small particles of tungsten are evaporated from the filament and collect on the lamp-

*Compiled by A. L. Powell, Lighting Service Department, General Electric Company.

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bulb in the form of a dark deposit. With the Mazda 'C' lamp the gas-current carries these particles to the upper part of the bulb, where they have less effect in absorbing light than when deposited directly opposite the filament. Nevertheless, any accumulation on the interior surface of the bulb absorbs light, and blackened lamps should be replaced. It is comparatively simple to figure out the most economic point at which to remove lamps from the socket, taking into account the price of lamps and the cost of current. For average conditions, when the candle-power has depreciated to 75 or 80% of the initial rating the lamp should be discarded. A photometric test might be desirable to determine exactly the percentage of depreciation, but observation and experience will soon indicate to the maintenance department when a lamp has depreciated to approximately this value. The Mazda lamp is designed to maintain its candle-power above the limits mentioned already for an average life of 1000 hours burning, and, at the end of this period, should be removed and discarded if the most economic conditions are to prevail.

Not only does a black deposit form on the inside of the lamp-bulb, but dust collects on the outer surface; flying particles of oil, or similar materials, are also deposited here. This accumulation cuts down the light from the lamp and should be removed at the time reflectors are cleaned. This is often more serious than realized.

Another important point is having lamps of the proper voltage. While initially the installation may be correct as to voltage, on replacing or ordering additional lamps, an error may be made in specifying the voltage of these lamps. Mazda lamps are designed to operate at the voltage indicated on the label. This voltage-rating takes into account renewal and energy costs. If the circuit-voltage is appreciably higher than the label-voltage, short life of lamps will follow. If the voltage at the socket is considerably lower than that indicated on the label of the lamp in use, it will not emit the proper quantity of light. To make up for this loss of illumination, it would be necessary to install additional lamps. For instance, seven Mazda lamps operating at rated efficiency will give an amount of light equivalent to that of eight Mazda lamps operating 4 volts below the rated efficiency of the lamps. Before ordering lamps it is desirable to determine what average voltage is actually attained at the socket. Where the voltage of the system fluctuates during the day, or where it varies in different parts of the installation, it is proper to order lamps as near the average of this variation as possible.

Lamps and reflectors should be regularly washed and cleaned. The period between cleanings will vary with locality and type of equipment. Obviously, a steel direct-lighting reflector will not depreciate as rapidly as an indirect unit. The under surface of the reflector of the former offers little opportunity for dust to gather, and that on the lamp-bulb will be the primary cause of loss. With the inverted unit, however, a thin layer of dust soon settles on the entire reflecting surface, as well as on the lamp, which will reduce the light output appreciably in a short time. Not only is this true, but the arrangement of parts makes the accumulation greater. With direct-lighting equipment, the reflector itself shields the lamp from falling particles, while they enter directly into the inverted unit.

Another feature enters in comparing direct and indirect systems. With direct lighting, the dirt gathers on the exterior surface and is readily visible to the occupants of the room. With the semi-indirect and totally indirect systems, the dirt gathers on the inner or reflecting surfaces and is not noticed until the illumination drops far below the intensity for which it was designed. Hence, careful maintenance of an indirect system is particularly important.

The color of walls and ceilings affects the efficiency of the lighting system. No matter how carefully painted a room may be, soot, smoke, and other agencies soon darken the surfaces of the room and cause it to lose much of its reflecting power. Any porous coating, such as calcimine or whitewash, is particularly susceptible to this effect. In industrial localities it is frequently necessary, if maximum economy of lighting is to be obtained, to paint the ceilings every year and a half and side-walls every three years. A test at frequent intervals, to determine the reflection coefficient of the ceiling and walls, may save lighting-bills. In general, paint is cheaper than electrical energy, and, in dirty plants, painting or cleaning is especially important.

Haphazard cleaning has not usually been found satisfactory, since the accumulation is so gradual that it is not readily noticed by those responsible. Much better success has been secured by organized cleaning, at stated intervals, under the charge of a maintenance department, where one person is responsible. As pointed out before, the periods between cleaning will vary with the locality and with the equipment. Considering average conditions and typical equipment, the fixtures in an office should be wiped out at least once every month, and removed for careful washing once every three or four months. In a foundry it is probably necessary to clean fixtures carefully once a week.

For dry dirt, wiping with a dry cloth or brush, then with a damp cloth, and finally drying all surfaces, will prove satisfactory. Greasy or wet accumulations on any type of reflector must be removed by washing. Soap and water are good agents, but care must be taken to remove the film of soap by rinsing thoroughly, as dried soap accumulates dust rapidly. There are a number of cleaners on the market, but before these are used on a polished surface care should be taken to make sure that they are so smooth as not to make microscopic scratches on the glass. They should not leave a film of cleaning-material. Most of them may be applied with a piece of cotton waste or soft cloth and polished with dry waste or cloth. Where lamps are hung high, and it is necessary to use a ladder to reach them, it is advisable to have on hand an extra globe, or reflector, which may be put in place of the dirty globe, and the latter carried to the cleaning-place. After washing, the clean globe can be substituted for the next dirty one, and so on. This procedure necessitates only one trip up the ladder for each globe or reflector.

Trade Notes

The Commercial Brass Foundry has moved to 550 Fourth street.

The United Welding Co. has opened a shop at 540 Van Ness avenue.

The Parr Terminal on the west waterfront of Oakland has been completed.

Duncan McCloud will erect a $50,000 machine-shop at Eighth and Gilman streets, Berkeley.

A $13,000 machine-shop will be built on Third near Clay street, Oakland, for **Joseph R. Karelin.**

The Montana Manufacturing Co. has commenced making pumps at its new plant at 199 Mission street.

The Friesley Aircraft Corporation is building aeroplanes at the Friesleben ranch near Gridley, California.

Factory extensions to cost $125,000 are planned by the **Superior Manufacturing Co.,** of Lodi, California.

A machine and forge shop, 60 by 100 ft., is being constructed by the **Anacortes Iron Works,** Anacortes, Washington.

Vehicles of all descriptions will be made by the **Pacific Carriage Building Co.** of Sacramento in a plant to be erected at Esparto.

The Skandia Pacific Oil Engine Co. has perfected arrangements, effective August 12, with the Travelers' Insurance Co. for group insurance covering its employees. The amounts

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of the policies range from $500 to $3000 apiece, according to length of service.

The Jack-Knife Windshield Co., manufacturing an automobile windshield, has completed a new factory at Georgetown, near Seattle.

A $500,000 factory has been completed at Howard and Eighteenth streets, for use of **Klopstock Bros.**, chair and table manufacturers.

The Milwaukie Machine Shop, Milwaukie, Oregon, will manufacture valve caps for automobiles and a patent nut-lock in its new plant.

A $35,000 plant at Noyo, Mendocino county, has been built by the **Pacific Sealing Co.** to extract seal-oil and to manufacture by-products.

A plant for manufacturing combined harvesters will be constructed by the **Jones Manufacturing Co.**, of Portland, at Vancouver, Washington.

The Metal & Thermit Corporation, of New York, will erect a factory on a 12-acre site at South San Francisco. About 300 men will be employed.

The plant of the **Malleable Steel & Iron Co.**, at Tacoma, has been acquired by the **Tennant Castings Co.**, which will manufacture steel castings.

The Los Angeles Shipbuilding & Drydock Co. has completed a floating drydock at its plant at San Pedro. The total cost was $1,200,000.

Jesse Bledsoe has acquired the interests of F. I. Drexler in the **Tulare Machine Works**, of Tulare, California, and is now the sole owner of the business.

The Stockton Tractor Co. has bought a four-acre tract at West Sacramento and will move its plant there from Stockton as soon as a building can be erected.

The Golden West Motors Co., which recently commenced the manufacture of motor-trucks at Sacramento, is increasing its output by putting on a night shift.

The Hadden Automatic Sprinkler Co. has leased a new brick building at 934 Maple avenue, Los Angeles, and is equipping it as a factory and machine-shop.

Arrangements are practically complete for the annual convention of the **American Foundrymen's Association** at Columbus, Ohio, during the week of October 4.

The Moreland Motor Truck Co. has developed an air-brake for use on 'trains' consisting of a motor truck and trailers. The brakes are controlled from the driver's seat.

The Pacific Alloy & Steel Co. is reconstructing its plant and will resume the manufacture of ferro-alloys in the electric furnace. George Driscoll is superintendent.

The California Packing Corporation is building a reinforced concrete packing-plant at P, Q, Second, and Front streets, Sacramento. The estimated cost is $800,000.

Contract for furnishing four miles of eight-inch steel pipe to the Terra Bella Irrigation district, in Tulare county, has been awarded to the **Western Pipe & Steel Company.**

Captain H. M. Gleason, who has been in charge of naval construction at Mare Island Navy Yard since 1910, has submitted his resignation, and will enter private business.

A company is being organized to construct a railroad from Wells, Nevada, on the Southern Pacific and Western Pacific railroads to Rogerson, Idaho, on the Oregon Short Line.

The Villemin, Job & Cheney Machine Works is erecting a one-story brick building on South Main street, Porterville, California, which will be used as a general machine and repair shop.

The Hall-Scott Motor Car Co. recently shipped a carload comprising 18 of its marine engines to its branch at Buffalo, New York, for distribution to buyers at various Great Lakes and Atlantic ports.

The Warren F. Fraser Co., of Westboro, Massachusetts, has issued a bulletin describing the latest additions to its line of grinding machinery, namely, the No. 31 and 32 semi-automatic grinders. These machines are adapted for grinding work of small diameter in large quantities at maximum speed.

Contract for the construction of two 12,000-ton tank-steamers for the Imperial Oil Co., of Toronto, has been awarded to the **G. M. Standifer Construction Co.**, of Vancouver, Washington.

Barr Bros. Co., making knives and miscellaneous specialties, is installing additional automatic machinery at its factory at 16 Seventh street, Oakland, in order to take care of increased business.

The Hutchinson Lumber Co. will proceed immediately with the construction of the first six miles of its logging railroad in Butte county, connecting with the Western Pacific railroad at Bidwell.

The Northwest Bridge & Iron Works, of Portland, has a contract to furnish 20,000 lb. of bolts, screws, washers, rods, and other equipment for a street-car line from St. Johns to Municipal Terminal No. 4.

The Pacific Coast Steel Co. will erect a building 88 by 320 ft. for mill and storage purposes at its plant near Seattle. Structural and other steel needed for the building will be manufactured by the company.

California Aerial Transport, the corporation that for several months maintained a passenger-carrying aeroplane service between San Francisco and Los Angeles, will wind up its affairs and retire from the business.

The second fire during the past six months at the plant of **Steiger & Kerr Stove & Foundry Co.**, 2021 Folsom street, occurred August 16. The main structure was saved but about $25,000 worth of damage was done.

The Bristol Co. recently issued bulletin No. 275, describing pyrometers, No. 286 describing electric recorders, No. 287 describing recording pressure and vacuum gauges, and No. 290 describing recording thermometers.

Contract for the construction of a nine-roller sugar-mill, having a capacity of 600 tons per day, on the island of Negros, Philippine Islands, has been awarded to the **Honolulu Iron Works Co.**, of Honolulu and Manila.

On account of the desire on the part of **John F. Craig**, founder and principal stockholder in the plant of the **Long Beach Shipbuilding Co.**, of Long Beach, to retire, the yard and equipment of the company has been offered for sale.

Under the title of 'Progress', the **Moore Shipbuilding Co.** has issued a beautifully illustrated booklet showing photographs of the company's shipyards and its various departments, as well as some of the ships and equipment constructed there.

Charles W. Rickard has been appointed secretary for the Washington district of the **United Metal Trades Association**, succeeding A. H. Garrison, who resigned to engage in business in Tacoma. Mr. Rickard's offices will be in the Alaska building, Seattle.

The Henneuse Tractor Co., which took over the old plant of the Liberty Iron Works near the northern city limits of Sacramento, has its tractor manufacturing now on a production basis. A general jobbing foundry is also being run in connection with the plant.

The Avery Co., of Peoria, Illinois, manufacturing tractors and other agricultural machinery, is erecting a building at Front and N streets, Sacramento. It will be used as the company's main assembling plant and distributing centre for the Pacific Coast territory.

The American Coin Register Co. has recently added two articles to the line of specialties that it is manufacturing, namely, a small centrifugal clothes-dryer, suitable for family use, and an axle for Ford cars, providing for four speeds forward and two reverse.

The U. S. Shipping Board will open bids on September 21 for the purchase of the Hog Island shipyard. The last of the 122 ships built there was completed and delivered on

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August 1. During the year ended July 21, 1920, a ship was launched for every 3 3/5 working-days.

Arthur P. Davis, director of the U. S. Reclamation Service, and President of the American Society of Civil Engineers, was in San Francisco on August 6 and addressed the members of the local section of the Society at a luncheon meeting on that date at the Engineers' Club.

The Pacific Gas & Electric Co. has applied to the State Railroad Commission for a certificate of public convenience and necessity for the construction of five or more power-plants on Pit river and its tributaries. The total estimated cost is $125,000,000 and 515,000 hp. will be generated.

Miner Chipman announces the opening of a course in Industrial Management to be given at the Butler School of Commerce in the Call building. Meetings will be held Tuesday and Thursday evenings, beginning September 2, and the course will require a minimum of 32 evenings work.

The Independent Pneumatic Tool Co., of Chicago, has issued catalogue No. 11, describing its line of 'Thor' pneumatic tools and electric drills. The pneumatic tools listed include drills, riveting and other hammers, sand-rammers, and motor-hoists. 'Thor' hose, couplings, and clamps are also described.

The Quigley Furnace Specialties Co., 26 Cortlandt street, New York, has issued a 16-page booklet on 'Hytempite in the Gas Plant', describing the use of this refractory material in laying firebrick and tile, and for repair work, as well as a number of other uses in the operation of gas-plants and of furnaces generally.

The U. S. Shipping Board opened bids on August 24 for the two 7500-ton concrete tank-steamers 'Palo Alto' and 'Peralta' built at the yard of the San Francisco Shipbuilding Co. in the Oakland Estuary. The advertisement of the sale stated that these vessels were scheduled to be completed about the latter part of August.

The Berger & Carter Co. has issued a useful chart showing decimal and metric equivalents of fractions of an inch, drill sizes, and tap-drill sizes for the Briggs, A. S. M. E., S. A. E., and U. S. standard threads. It is printed in large letters and figures on heavy paper, so that it is suitable for hanging on the wall of the shop or drafting-room.

Plans for the reorganization of the **Lucey Manufacturing Corporation** have been perfected. They call for the issuance of $1,500,000 in ten-year 8% notes, 37,500 shares of 'class A' stock, par value $50, and 100,000 shares of 'class B' stock, of no stated par value. The 'class B' stock is to be exchanged for the present outstanding common stock.

The city of Los Angeles has awarded contracts for furnishing about $300,000 worth of riveted-steel water-pipe for use in the Westgate district. The work was about equally divided between the **Los Angeles Manufacturing Co.,** the **Lacy Manufacturing Co.,** the **Western Pipe & Steel Co.,** the **Llewellyn Iron Works,** and the **Baker Iron Works.**

Frank E. Covey, formerly with the Cyclops Iron Works, is organizing the **Yankee Ace Manufacturing Co.** to manufacture an internal-combustion engine developed by him. It is claimed that this engine is noiseless and that it has a higher efficiency and a lower weight per horse-power than any of the present types. He expects to build a factory for manufacturing the engine at Stockton.

The 12,000-ton dry dock recently purchased by the **Bethlehem Shipbuilding Corporation** from the Ames Shipbuilding Co. of Seattle, will be in operation by the first week in September. The No. 3, at Hunters Point graving dock, is now accommodating the Southern Pacific ferry-boat 'Contra Costa', which is docked for repairs. The boat is to be copper sheathed and planked at a cost of over $100,000.

An unusual step has been taken by the **Homer Furnace Co.,** of Coldwater, Michigan, in starting a class among its employees in foundry technology under the auspices of **McLain's System, Inc.** The course will take one year, and the company will pay half the cost of the course for all employees that complete it. The number of employees taking the course, which will start about September 1, is 22.

The Colmar Manufacturing Co., which formerly operated in San Francisco under the name of the Colmar Burner Co., has completed a 40 by 80 ft. concrete factory building on Park avenue, Emeryville, and is installing machinery. The plant will be on production about October 1. The company manufactures kerosene-oil burning equipment for heating apartment-houses and residences.

The Berger & Carter Co. has issued a well-illustrated catalogue of more than 700 pages, describing the food-preserving machinery and supplies handled by the company. Besides machinery especially designed for use in the canning and packing industries, the catalogue also lists such general equipment as hand-trucks, pumps, and time-clocks. A numbeer of useful mathematical and other tables are also included in the catalogue.

The Cass Manufacturing Co. will spend $100,000 on the construction of a new plant on the block bordered by Cheney, Minerva, and Edwin streets and the Santa Fe railroad tracks at Los Angeles. This company was organized in February 1919 by B. H. Cass, following the disposal of his holdings in the Cass-Smurr-Damerel Co. The company manufactures hotel-kitchen supplies, including ranges, furnaces, fans, and ventilating machinery. The foundry in the new plant will have a four-ton cupola.

The Kerckhoff hydro-electric project of the **San Joaquin Light & Power Corporation** on the San Joaquin river near Auberry was completed and placed in operation August 15, over a month ahead of schedule time. The plant cost between $5,000,000 and $6,000,000 and will generate 50,000 hp. The Corporation has also started work on a steam-electric plant near Buttonwillow, Kern county. Natural gas is to be used for fuel. The first unit of the plant will cost $1,750,000 and will be completed about April 1 next.

The Industrial Department of the **Pacific Gas & Electric Co.** reports the following recent installations of gas-burning apparatus in shops in San Francisco: **Fitzpatrick Products Co.,** 883 Bryant street, a Tate-Jones cyanide furnace and a heat-treating oven to be used in the manufacture of stump-puller parts. **Main Iron Works,** 7th and Daggett streets, a Selas gas-mixing apparatus to supply fuel for about 15 rivet-heaters and flange-fires. **The Lathe Tool Co.,** 170 Second street, a gas-fired tool-oven for treating dies, milling cutters, and similar articles.

The Super-Refining Process Corporation and the **Super-Refined Metals Co.** have been organized by a group of Los Angeles capitalists including John B. Miller, Henry M. Robinson, William R. Staats, G. A. Beaton, and others, to take over the patents and other details of the business developed by W. H. Kelly for manufacturing high-grade bearing metals. 'Kelly' metals have been made at Los Angeles for the past six years, but the business will now be expanded considerably. New factories are to be built at Detroit and Chicago, and the present plant at 315 West 33d avenue is to be enlarged.

Announcement is made of the incorporation of the **Link-Belt Pacific Co.** to take over the entire interests of the **Link-Belt Co.** in California, Nevada, and Arizona. The latter company has maintained branch offices in San Francisco and Los Angeles for a number of years, but the growth of its business on the Pacific Coast has brought about the necessity of expansion. The new company's principal place of business will be at San Francisco, the Los Angeles office being operated as a branch. The directors are Charles Piez of Chicago, who is also president; Harold H. Clark of San Francisco, vice-president and treasurer; B. A. Gayman of Chicago, vice-president; and Guy C. Sylvester, of Los Angeles, secretary. The Los Angeles branch, in charge of Mr. Sylvester, is at 161-163 North Los Angeles street. The San

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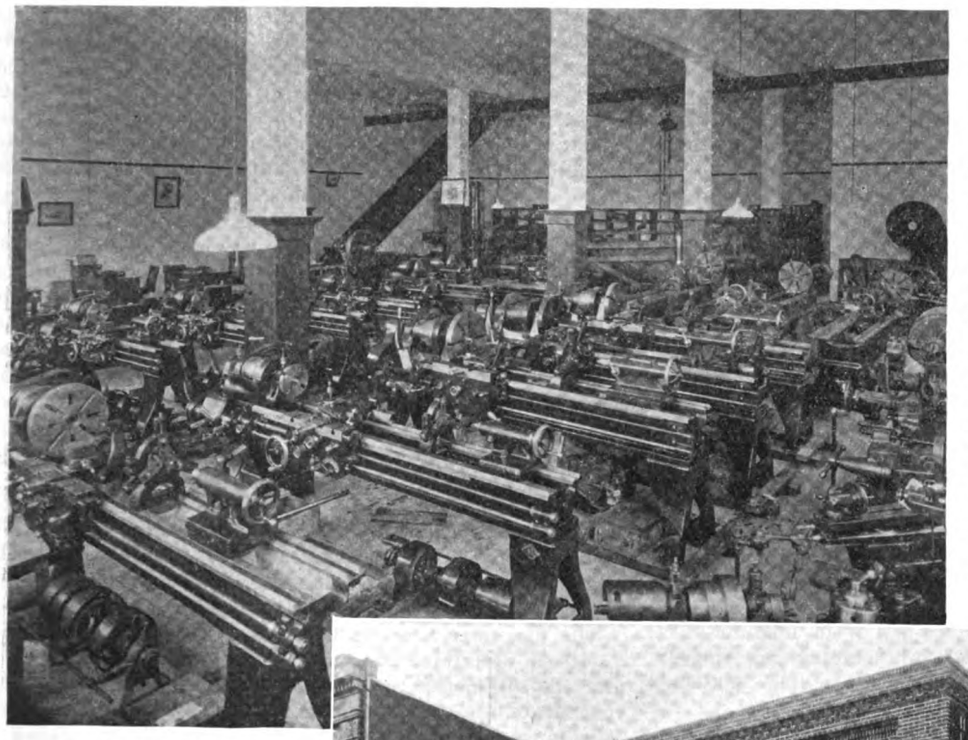
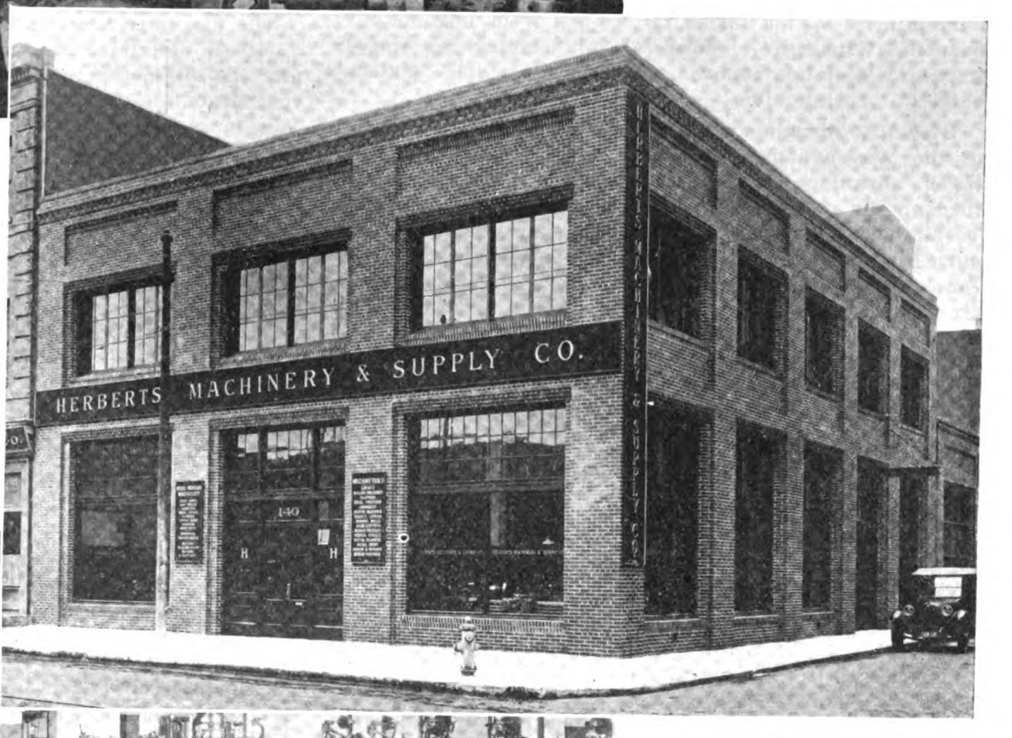


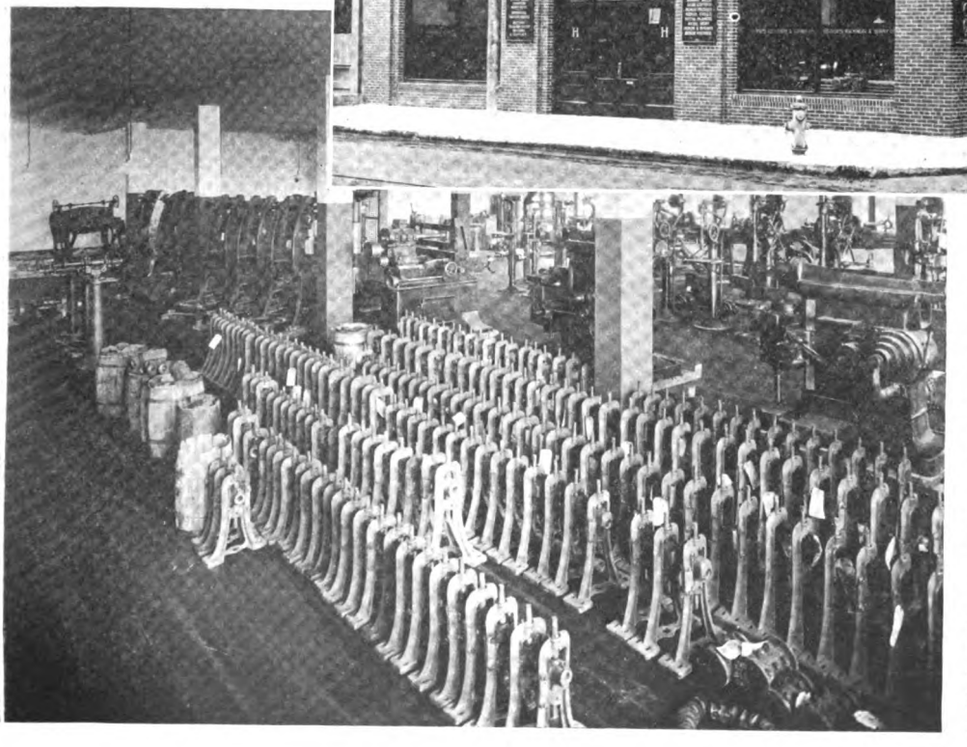
MAIN FLOOR

Francisco office is at 168 Second street, where the company has just leased suitable quarters. The plan is to carry larger and more complete stocks than heretofore; this being made necessary by the increasing demand in this territory for Link-Belt machinery and service.

DISPLAY ROOM ON SECOND FLOOR



EXTERIOR OF BUILDING



Herberts Machinery & Supply Co. has moved from its Second street store to a new building erected for the company at 140 First street. It has two stories with a basement under the entire building. The total floor space is 12,500 sq. ft., which gives the company the largest display rooms in the city devoted exclusively to machine-tools. Eighteen months ago the company opened it San Francisco office at 168 Second street. Since then the aggressive sales policy of the company and its excellent service to the trade have so increased the volume of its business as to make necessary a larger display space for the complete line of machine tools which it carries.

The president of the company is C. A. Herberts, who is also acting manager, and is in direct charge of the main office in Los Angeles. Mr. Herberts has been in the machine-tool business for many years and is well and favorably known through the Western sales-territory. His popularity extends not only to the trade but to his competitors as well. He has indeed made an enviable record during the past few years in building up one of the strongest machine-tool houses on the coast. The San Francisco house is under the

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management of B. J. Flanagan. It is due to his efforts and policy that this branch has had such phenomenal growth. The entire corps of salesmen are practical men. This enables them to give the utmost service to their customers, as they not only have a thorough knowledge of the capabilities of their lines of tools but also have an extensive knowledge of production methods and mechanical problems. The latest addition to Herberts' service is Vernon C. Wear, who comes from the Foster Machine Co.'s plant at Elkhart, Indiana, where he had many years experience in estimating and engineering problems, which is proving of great value to the local trade. The company is the exclusive representative on the coast for many of the finest machine-tools manufactured. The line is particularly complete and covers all the needs of the modern shop. Among the companies represented may be mentioned the following: Hamilton Machine Tool Co., heavy-duty production lathes; Cincinnati Shaper Co., heavy-duty shapers; Foster Machine Co., screw-machines and turret-lathes; Minster Machine Tool Co., Hi-Duty drilling machines; Monarch Machine Tool Co., engine-lathes, sizes 10 to 30 in.; Mueller Machine Tool Co., radial drills; Rahn-Larmon Co., quick-change lathes; Rockford Drilling Machine Co., upright drill-presses; Rockford Milling Machine Co., universal and plain millers; Rockford Lathe & Drill Co., economy lathes; U. S. Machine Tool Co., hand millers; Whipp Shaper Co., 16 and 20-in. medium-duty shapers; Wilmarth & Mormon Co., grinding machinery; Rockford Tool Co., tool-room lathes; Bloomquist-Eck Machine Co., boring-mills.

Over 90% of the employees at the East Pittsburgh Works of the **Westinghouse Electric & Manufacturing Co.** have taken advantage of the additional insurance available through the insurance and savings plan recently adopted. To be eligible for additional insurance, an employee is required by the company to deposit part of his earnings in the Employee's Savings Fund. Each employee, after completing six months' service with the company, is given a $500 life-insurance policy, free of charge and without any restrictions. By continuing with the company and depositing at least 2% of his earnings in the Employees' Savings Fund, he may obtain additional insurance, ranging from $500 to $1500, according to length of service. A policy of $1000 to $2000 may therefore be obtained by every employee depositing in the Fund, which pays interest at the rate of 4½% compounded semi-annually. To assist an employee to meet an emergency, loans will be made from the Fund. Any depositor can borrow 90% of the money he has in the Fund without affecting the value of his insurance.

With accepted applications for space near the 600 mark, a new record, the **Sixth National Exposition of Chemical Industries** in Grand Central Palace, New York, September 20 to 25, inclusive, is certain to outclass the five previous ones. The program, aside from the exposition proper, is also the most extensive that has ever been arranged. On the afternoon of September 23, the Chemical Engineers will hold a meeting in the afternoon. Three other symposiums will be held during the week. One will be on fuel economy, one on material handling, and one on industrial management. Entering as it does practically every phase of industry, the exposition offers a remarkable opportunity to the manufacturer and business man to see what has been accomplished since American chemists entered the field in earnest. Discoveries that have revolutionized many manufacturing processes have been made. These have increased production, improved the quality of the merchandise, and paid dividends to the investors. A feature of this year's exposition will be moving pictures. These will show how American chemical engineering has advanced. The subjects will be placed before the public in a manner that will enable even the novice to understand the difficulties that have been overcome during the past five years.

The C. L. Best Gas Traction Co. is proceeding with the expansion of its facilities at its factory at San Leandro preparatory to placing its new 30-hp. tractor on the market during the season of 1921. Extensions are being built to the machine-shop and assembling departments, the facilities of the heat-treating department are being doubled, and a quantity of machine-tools and other equipment is being installed. The old gray-iron foundry has been converted into a woodworking shop. Iron as well as steel castings are now being made at the nearby plant of the Best Steel Casting Co. Jigs and fixtures for the new tractor are being designed and made, and it is expected that the tractor will be on a production basis about January 1. The new machine will weigh and cost approximately half as much as the 60-hp. tractor. Manufacture and sale of the 60-hp. machine will be pushed as before, the new tractor being intended primarily for the farmer or other user whose operations are on too small a scale to warrant the purchase of the larger and more expensive machine. Funds for the expansion of facilities are being obtained from the sale of the $1,250,000 issue of 8% preferred stock recently placed on the market. The company's balance-sheet for June 30 last showed assets of $2,511,133.90, surplus, subject to provision for Federal taxes, $739,121.09, and net earnings for the first six months of 1920, $404,399.56.

The Van Dorn Electric Tool Co., of Cleveland, has issued a bulletin describing pedestal and bench grinders with many new improvements that make for power, stability, motor ventilation, and utility. The motor is built complete in the Van Dorn factory and is insulated, tested, and rated by standards of the American Institute of Electrical Engineers with ample power to drive a 1½ by 10-in. wheel without stalling. The normal rating is 1⅛ hp., momentary overload 2¼ hp. With ventilation in continuous service, the temperature-rise is less than 50°C., and, fully enclosed, the motor will not have a temperature-rise exceeding 55°C. in 30 minutes at 1⅛-hp. load. The speeds are as follows: direct-current 2000 r.p.m., alternating-current 60 cycles, 1800 r.p.m. The diameter of the motor frame is less than that of the wheel, therefore, work can be handled flat against the wheel without being forced out of position by an extending frame. The shaft is mounted in large ball-bearings with the inner races correctly locked to the shaft to provide end-thrust and minimize the wear on the shaft. The bearing-housings are dust-proof. The supports are directly under the bearings, a great improvement over a single support under the centre of the motor. Ventilation is by a large centrifugal fan, which creates a forced draft, taking in the air through protected openings at the rear of the motor. Should conditions require the piping of air to the motor, such a connection is easily made. Or, should it be advisable to remove the grinding-dust by an exhaust system, this attachment can be made to a flange provided on the wheel-housing.

J. Stewart Clark and **Frank F. Frasier** have opened a storage-battery assembling plant and distributing station at 112 East Miner avenue, Stockton. They will handle the 'D-G' battery, for which they have the exclusive rights for twelve Western States as well as the foreign rights.

The Doud MacFarlane Machinery Co. has moved its old plant to a modern group of buildings on a five-acre tract at Cedar and Center streets, Tacoma.

Our front cover this month shows a Schwartz brass-furnace at the plant of the **National Smelting Corporation.**

POSITION WANTED

SHEET METAL WORKER seeks connection with large shop as foreman or superintendent. Capable estimator, lay-out, etc., building material, metal windows and doors, heating and ventilating, tanks, stampings; also specialties. Best of references as to ability and character. Member A. S. M. E. P. O. Box 14, Station A, Berkeley, Cal.

POSITION WANTED

FACTORY SUPERINTENDENT or general foreman, capable of taking entire charge of large machine-shop. Twenty-five years experience in all branches of manufacturing industry. Also qualified draftsman and designer. Address PW 111, Metal Trades, 420 Market St., San Francisco.

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